

WORLDWIDE CHALLENGES TO NAVAL STRIKE WARFARE

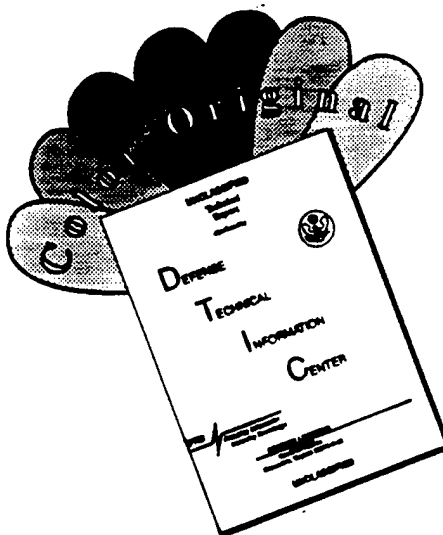
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PROLOGUE

*Worldwide Challenges to Naval Strike Warfare is intended to expand the dialog on the **context, environment, and challenges** against which U.S. Naval Strike Warfare will operate now and until 2015. As U.S. Naval Strike Warfare approaches the next century, it does so with more flexibility, responsiveness, precision, and potency than ever before. However, the challenges that it will face in the decades ahead are also more diverse and more demanding than ever before.*

*Just as in the over 200 times since World War II that it has been called upon, U.S. Naval Strike Warfare will again be asked to respond to crisis; often the first U.S. force on scene, and often in locations far distant from home, without benefit of allied support. This new **context** will not focus on historic U.S.-Soviet animosities, but rather on new, emerging, major regional conflicts, or aggression by unstable or rogue states, or in response to International Arms Proliferation, or Transnational Criminal Activity.*

*United States Naval Strike Warfare will operate in an **environment** of decreased U.S. base support overseas. Rising ethnic nationalism, contracting alliances, budget pressures at home, and proliferation of precision technology will highlight simultaneously the value of forward presence and the difficulties in sustaining it. In this new environment, forward naval presence and the impact of naval strike warfare will become even more apparent and more valuable to our policy makers.*

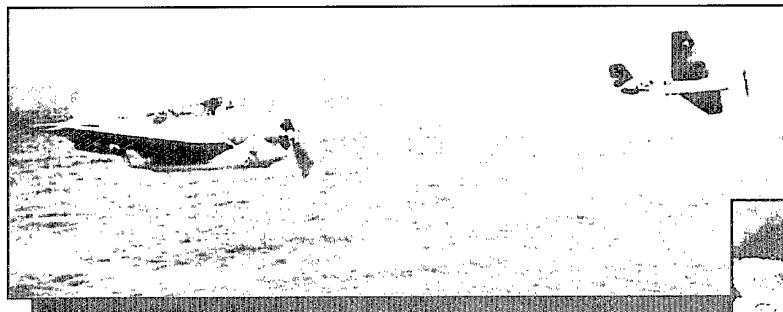
Real-time, on-the-scene reporting of crises around the world will encourage rapid and precise military responses. Coverage will be integrated globally, with a space component, to focus on military operations in ways yet unimagined. At the same time, the penchant for "surgical strikes" will make "soft" kills and "smart," precision weapons, weapons of choice. Public intolerance of hostage taking and loss of life generally will place greater emphasis on "zero defect" military operations.

The technology and lessons learned from Desert Shield/Desert Storm have not been lost on regional actors, aspiring Third World Nations, or International Criminal Cartels. The importance of integrated tactics, all-weather operations, command and control warfare, stealth, precision weapons and applications of the global positioning system are appreciated by all and pursued by many.

*Ironically, the West, itself, will create many of the **challenges** in technology proliferation in the coming decades. Russia, struggling to maintain its superpower status, will reduce its aircraft and air defense industries, but still will be willing to sell advanced technology for hard currency to sustain its research and development base. China, hoping to leap to "world class" status, will invest heavily in Western technology and pay for it, in part, by sales of low cost alternatives. New and old actors like North Korea, Iran, and Iraq will buy new aircraft and air defense systems to advance their regional ambitions.*

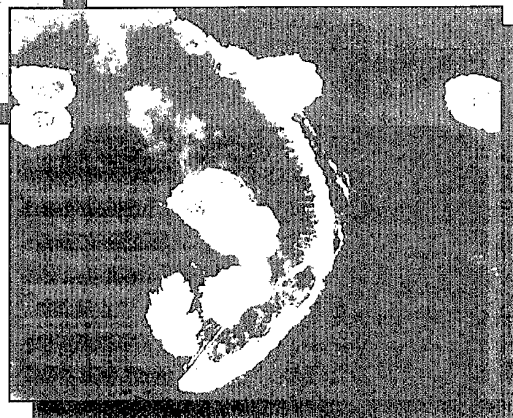
To make the right choices for the Navy and the Nation, it is important to understand the context, environment, and challenges that lie ahead by engaging in the dialog on the Worldwide Challenges to Naval Strike Warfare.

NAVAL STRIKE ROOTS: WAR - AT - SEA

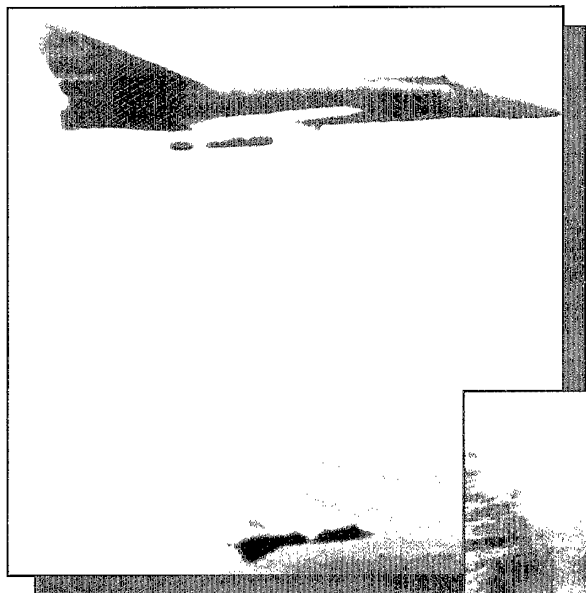


WORLD WAR II
1945

During World War II, aircraft became an integral part of naval strike warfare. The ability of aircraft to appear unexpectedly, anywhere within the battle space, made them particularly effective. The vulnerability of surface ships operating without air cover was demonstrated when 300 carrier-based aircraft sank the world's largest battleship afloat, the Japanese YAMATO, along with its six escorts, on 7 April 1945.

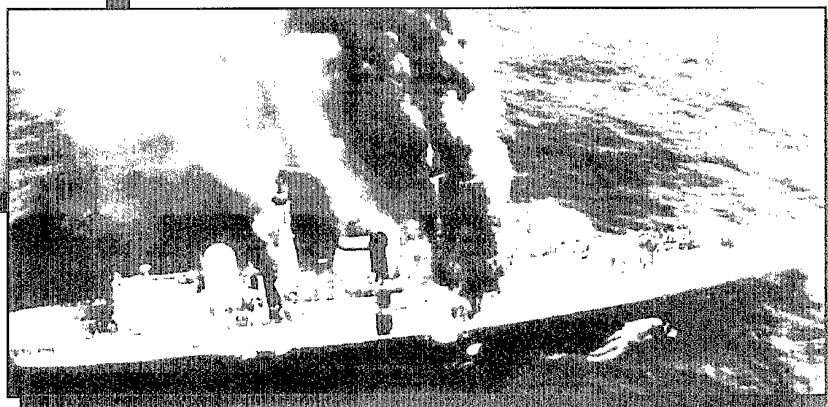


(Above left) Grumman TBF-1 launches torpedo. (Above) IJNS YAMATO under torpedo and bomb attack.



FALKLAND/MALVINAS ISLANDS
1982
UNITED KINGDOM/ARGENTINA

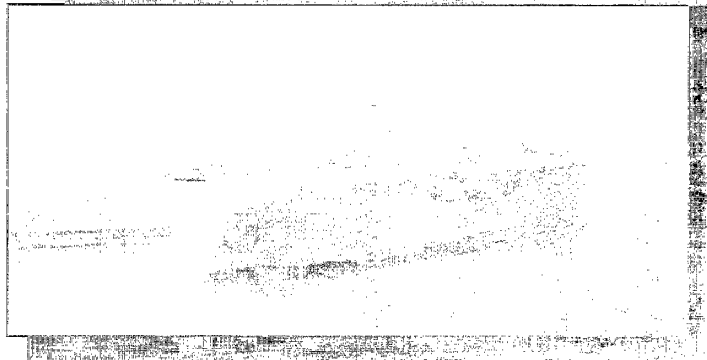
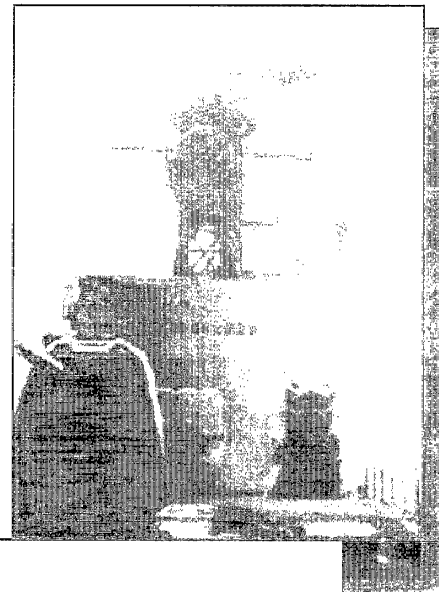
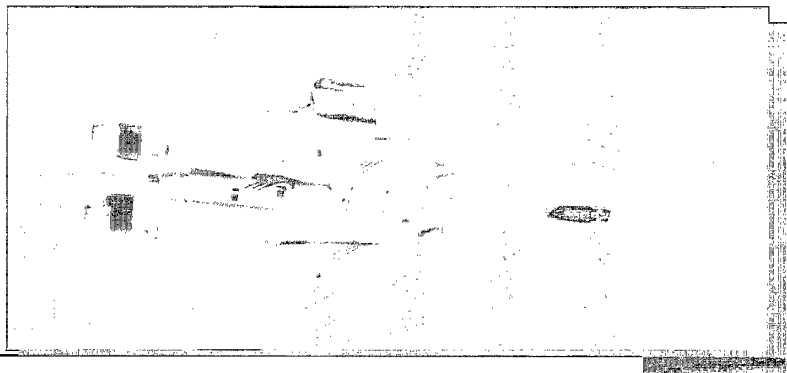
The value of naval strike warfare is undiminished today, particularly with the addition of precision-guided bombs and cruise missiles. However, as aircraft, cruise missiles, and precision-guided bombs have grown in capability, so has the sophistication of the air defense systems used against them.



The HMS SHEFFIELD (above) sank after being damaged by an EXOCET antiship missile launched from an Argentinian SUPER ETENDARD (above left).

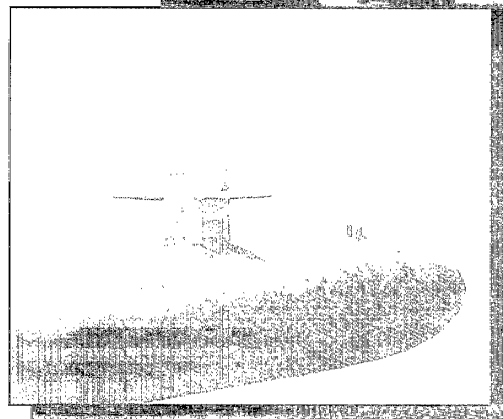
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NAVAL STRIKE WARFARE TODAY...

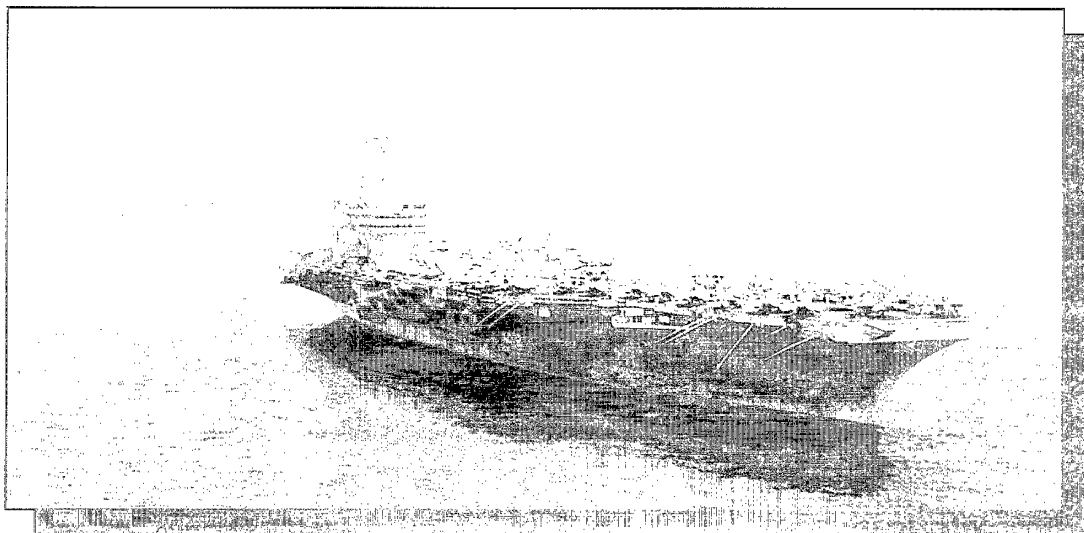


(Top) F-14 TOMCAT with TARPS reconnaissance pod and (below) an amphibious ready group.

Naval strike warfare encompasses the range of weapons, platforms and tactics designed to project power ashore, on short notice, against a wide range of strategic, operational, and tactical targets in the face of sophisticated air defense systems, during day and night, in all weather conditions.

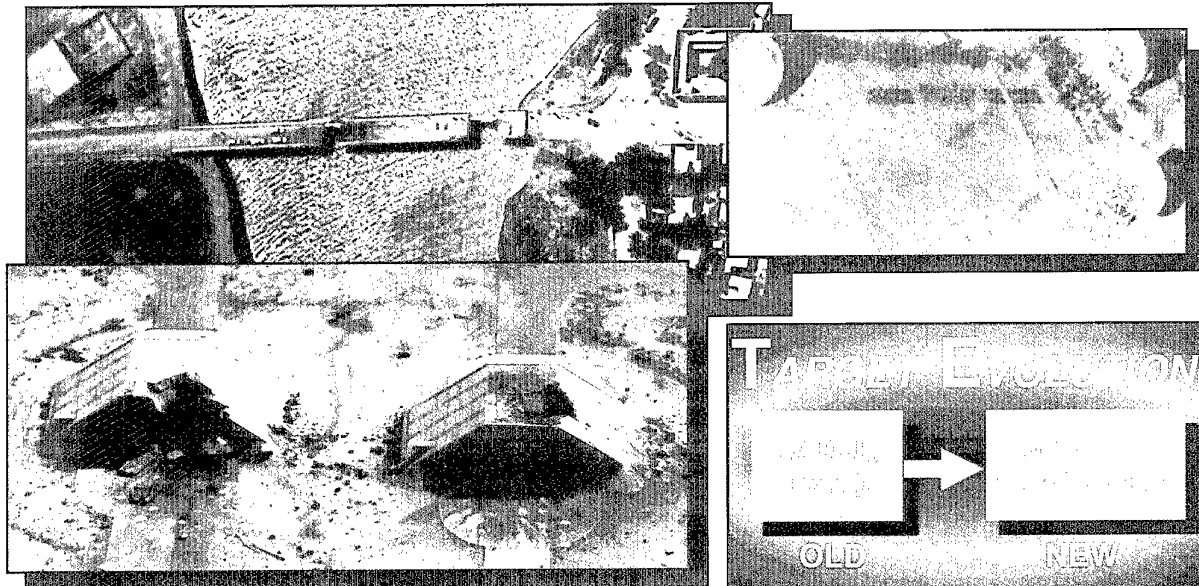


Surface and subsurface launched TOMAHAWK missiles.

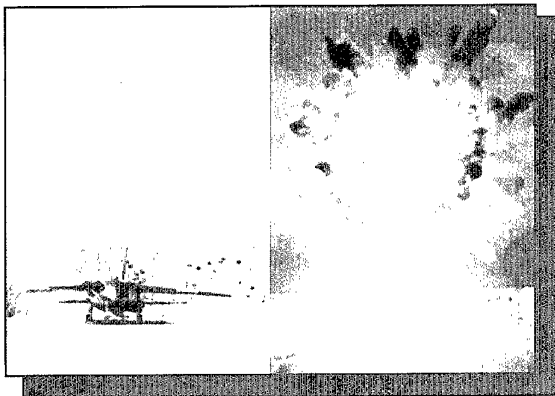


USS DWIGHT D. EISENHOWER (CVN 69) with aircraft on deck.

... *ORDNANCE ON TARGET!*

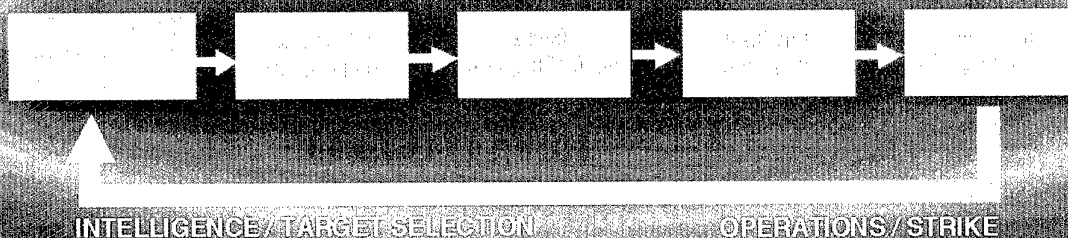


Destroyed highway bridge and hardened aircraft shelters (above), damaged communications dishes (right), and TOMAHAWK attack on revetted aircraft (below).

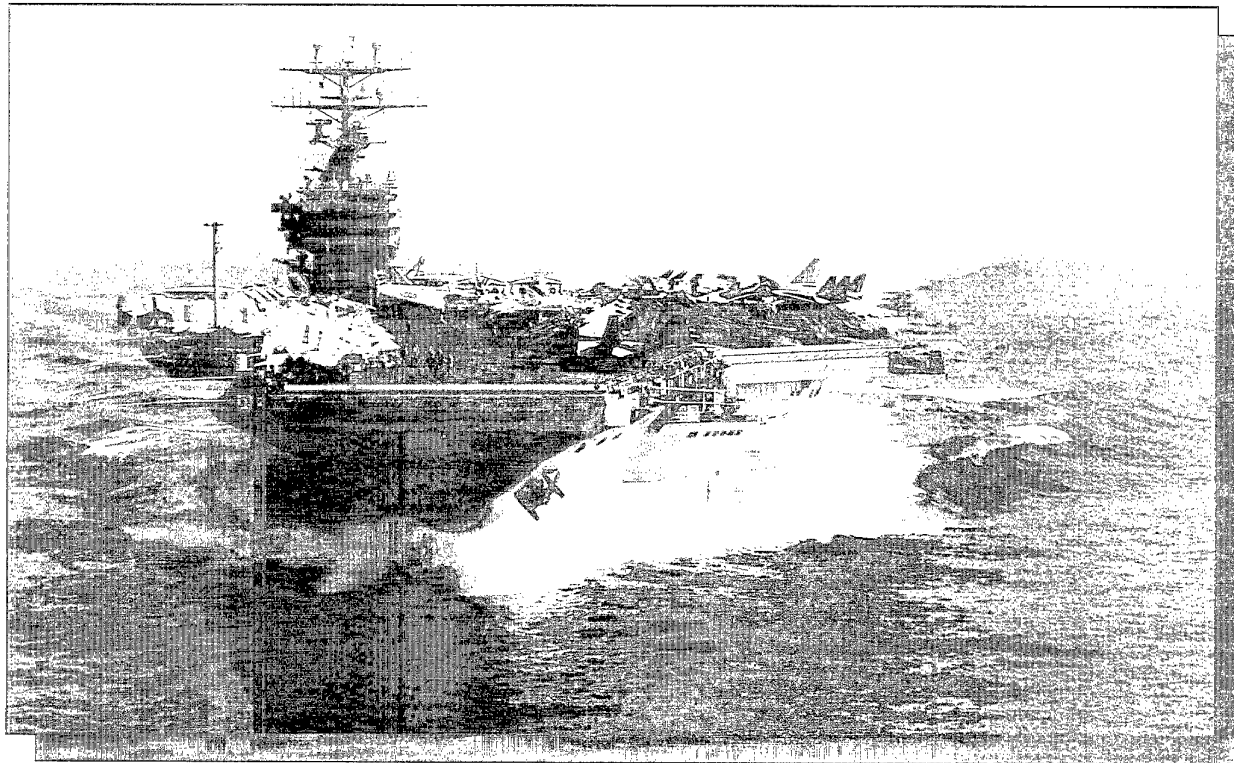


The key to destroying an opposing combat force is to disrupt its infrastructure as well as to attack the forces themselves. Severing the link between national command authorities and senior tactical commanders will diminish coordinated and joint military operational effectiveness. Once lines of communication and routes of resupply and movement are eliminated, support to soldiers becomes difficult at best. Lacking nationally coordinated decisions and a full support structure, the forces can be destroyed piecemeal. Precision strike weapons have made naval strike warfare even more potent and accurate in modern targeting.

FUNCTIONAL COMPONENTS OF PRECISION STRIKE



UNITED STATES AIRCRAFT CARRIER POWER



USS ABRAHAM LINCOLN (CVN 72) at sea.

UPON COMMISSIONING OF CVN 76 AND RETIREMENT OF USS KITTY HAWK (CV 63) IN 2002, OUR CARRIER FORCE WILL BE AS FOLLOWS:

USS RONALD REAGAN (CVN 76)
 USS HARRY S. TRUMAN (CVN 75)
 USS JOHN F. KENNEDY (CVN 74)
 USS GEORGE EASTMAN (CVN 73)
 USS ABRAHAM LINCOLN (CVN 72)
 USS THEODORE G. BATES (CVN 71)
 USS CARL VINSON (CVN 70)
 USS DWIGHT D. EISENHOWER (CVN 69)
 USS NIMITZ (CVN 68)
 USS JOHN F. KENNEDY (CV 67) (RESERVE)
 USS ENTERPRISE (CVN 65)
 USS CONSTELLATION (CV 64)

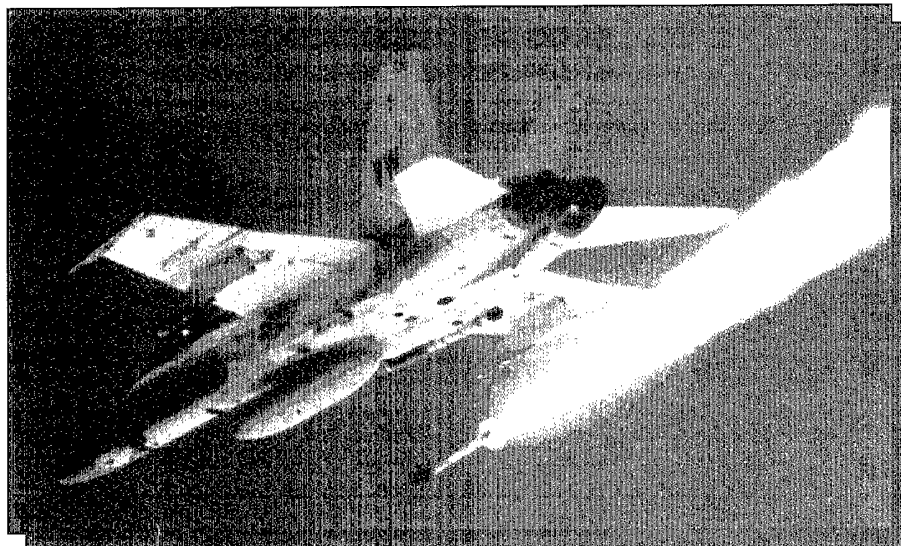
The United States currently operates 12 versatile aircraft carriers with associated airwings. These systems represent the primary strike arm of the Navy. They are frequently called upon by national policy makers to conduct measured responses, from humanitarian support to combat. The forward presence of a carrier battle group is a concrete demonstration of U.S. interest in a region and can go far toward averting crises.

The carrier airwing is composed of a number of aircraft types. The F/A-18 HORNET is the airwing's premier strike fighter. The introduction of the F/A-18 E/F SUPER HORNET will keep the family at the leading edge of capability. The F-14 TOMCAT is the finest interceptor in the world. It is being upgraded with a potent strike capability to give the TOMCAT a true multi-role mission. Strike force multipliers include the E-2C HAWKEYE early warning and command and control aircraft, the EA-6B PROWLER electronic warfare aircraft, and the ES-3A SHADOW signals intelligence collector.

CARRIERS: VERSATILE AND FLEXIBLE







U.S. AIRCRAFT CARRIER FEATURES

- 600,000 TONS
- 1,000 FEET LONG
- 250 FEET WIDE
- REPOSITION UP TO 700 MILES PER DAY
- 4.5 ACRE FLIGHT DECK, OVER 1,000 FEET LONG AND OVER 250 FEET WIDE



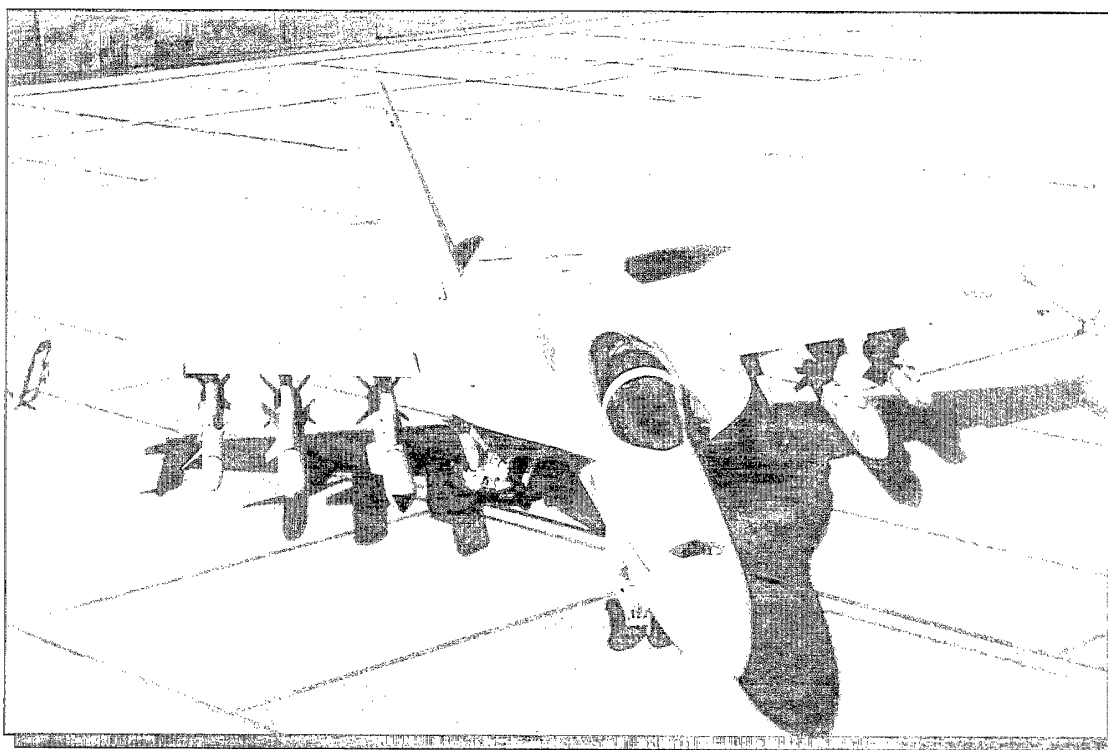
F-18 HORNET fires a SIDEWINDER missile.

CARRIER SORTIE GENERATION

	AIRCRAFT		SUSTAINABLE SORTIES/DAY
	FIXED-WING	HELO	
 U.S. NIMITZ	68-80	6	140+
 FRANCE CHARLES DE GAULLE			80 68
 RUSSIA KUZNETSOV			65+
 U.K. INVINCIBLE			38
 SPAIN PRINCIPE DE ASTURIAS	26	12	38
 INDIA VIRAT VIKRANT	28 16	8 12	36 28

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AVY STRIKE AIRCRAFT

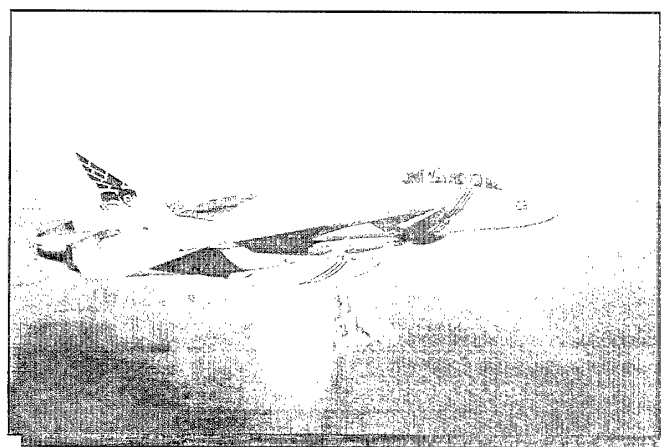


The F/A-18E SUPER HORNET first flew on 29 November 1995.

The Navy's premier strike fighter for the future is the F/A-18 E/F SUPER HORNET. It incorporates a number of improvements over today's F/A-18 C/D including:

- 25% larger wing
- new engines
- up to 40% more range
- updated cockpit
- additional weapons stations
- reduced radar signature
- increased survivability
- growth potential

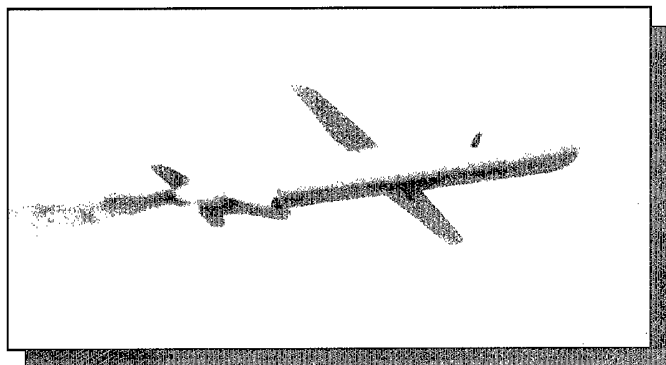
The F/A-18 E/F will be able to employ a wide variety of precision-guided weapons including laser-guided bombs and the new family of joint attack weapons (JDAM and JSOW). This important strike capability is achieved without compromising air-to-air performance.



F-14 TOMCAT

The F-14 TOMCAT entered service in the mid-1970's and remains one of the premier air-to-air aircraft today. It is being upgraded to launch precision-guided air-to-surface weapons and will provide a multi-mission strike/escort capability until at least 2010.

TOMAHAWK CRUISE MISSILES



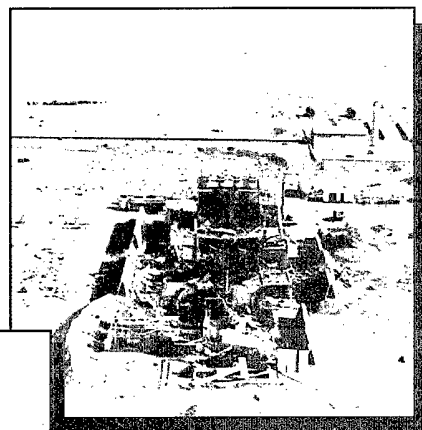
TOMAHAWK cruise missile en route to its target.

The TOMAHAWK provides an effective strike capability against targets without putting a flight crew at risk. TOMAHAWK was proven during Desert Shield/Desert Storm and continued to demonstrate its benefits during subsequent actions in Iraq and Bosnia. The current production standard TOMAHAWK uses the global positioning system (GPS) to allow greater mission flexibility. Future upgrades to the TOMAHAWK will continue to provide naval strike forces with a potent alternative to strikes by manned aircraft. TOMAHAWK's unique capabilities make it a capable complement to the carrier airwing.

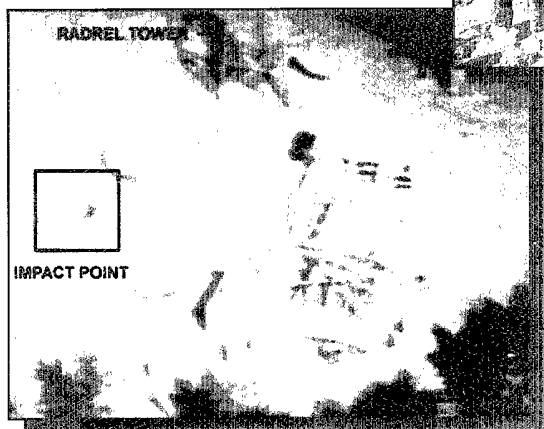
TOMAHAWK STATISTICS

LENGTH:	16 FT 10 IN
WINGSPAN:	10 FT 10 IN
MISSILE WEIGHT:	4,500 LBS
WARHEAD WEIGHT:	1,000 LBS
SPEED:	500 MPH
RANGE:	1,100 MILES

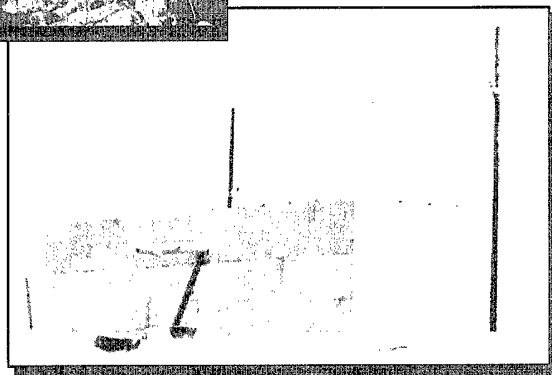
(Right) Iraqi Intelligence Service Building, June 1993



(Above) Samara Chemical Facility, Iraq, January 1991



Lisina Mountain military radio relay, Bosnia, September 1995



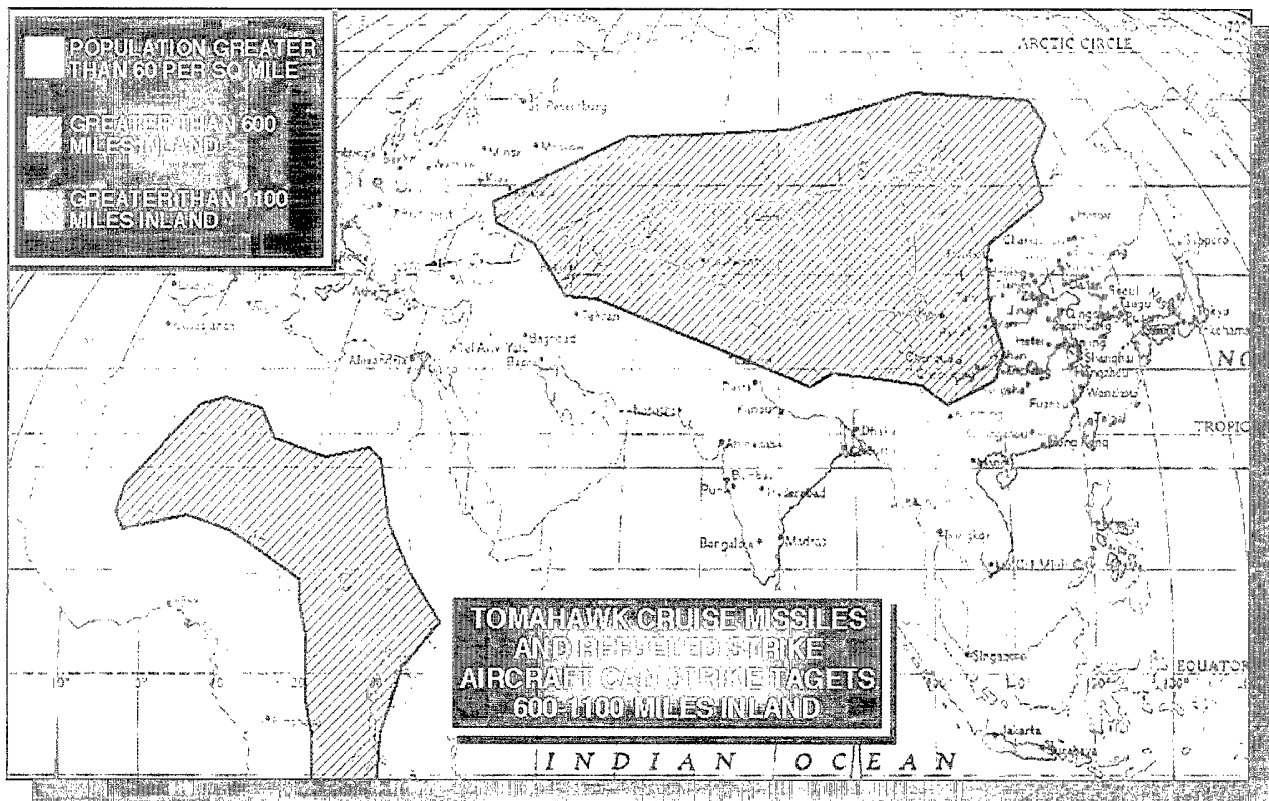
Hard target kill test

RANGE OF U.S. NAVAL STRIKE FORCES

Forward presence remains an important part of U.S. Navy operations, as demonstrated in the over 200 responses to crises conducted by naval strike warfare assets since World War II. It allows the rapid establishment of control of the air, sea, and space en route to and in the theater of operations. In some cases, forward deployed naval forces may be the only option available in the early stages of a crisis. Forward presence

means rapid employment of combat power where it is needed most.

Many challenges and challengers will arise during the next two decades. The vast majority of them, if not all, will be within the range of a possible response by naval strike warfare forces. These forces will remain available to implement the policies of U.S. national decision makers.

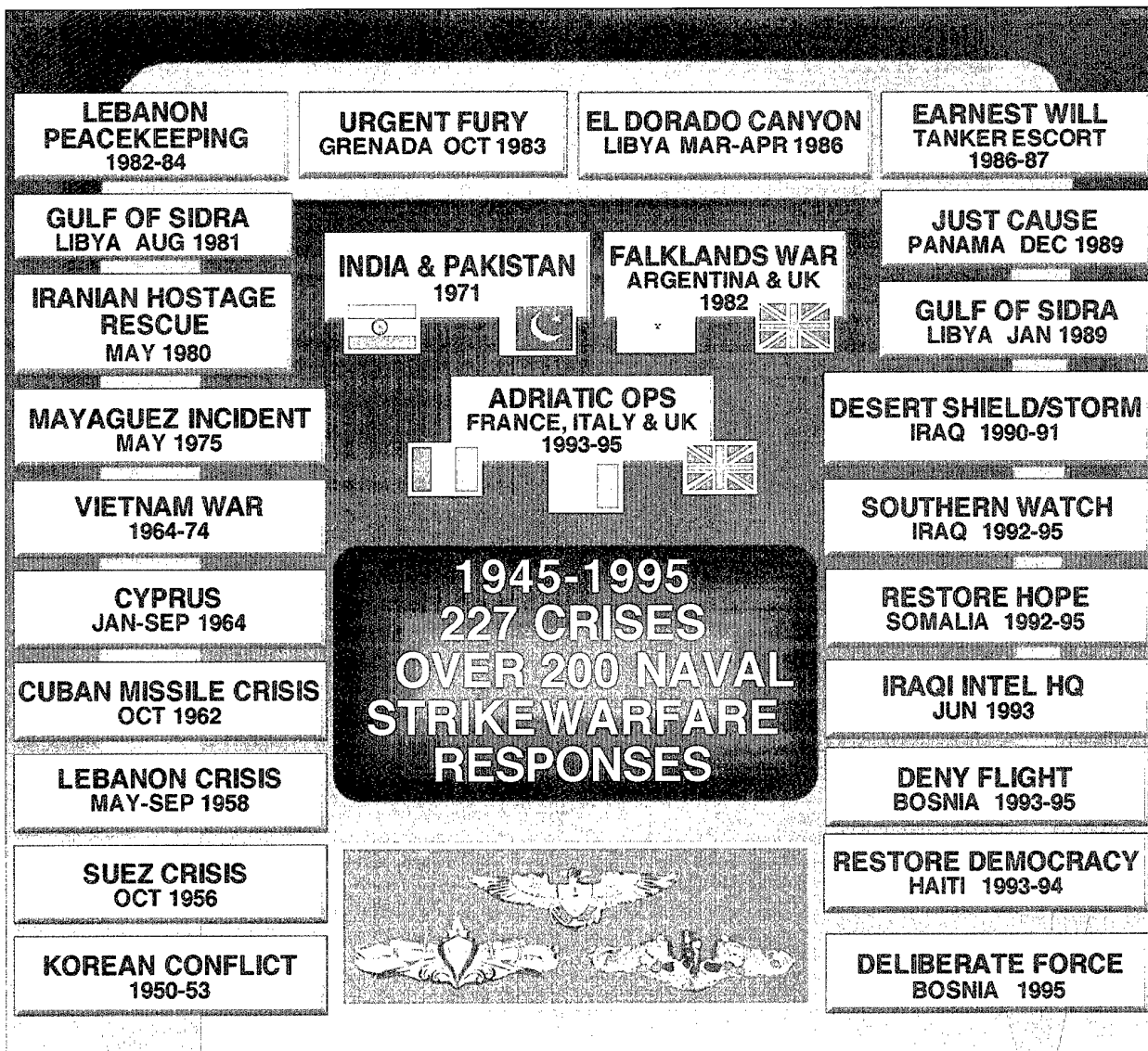


The earth's coastal zone accounts for only 8% of the world's surface area, yet hosts 26% of the world's agricultural productivity and major spawning areas, and houses 66% of humanity. Eighty percent of all international trade is carried by ship - which is why 9 of the world's 10 largest cities and 33 of the top 50 are near coasts.

NAVAL STRIKE WARFARE AND CRISES

"Most fundamentally, our Naval Forces are designed to fight and win wars. Our most recent experiences, however, underscore the premise that the most important role of Naval Forces in situations short of war is to be engaged in forward areas, with the objectives of preventing conflicts and controlling crises."

*- THE HONORABLE JOHN H. DALTON
SECRETARY OF THE NAVY
"FORWARD...FROM THE SEA"*

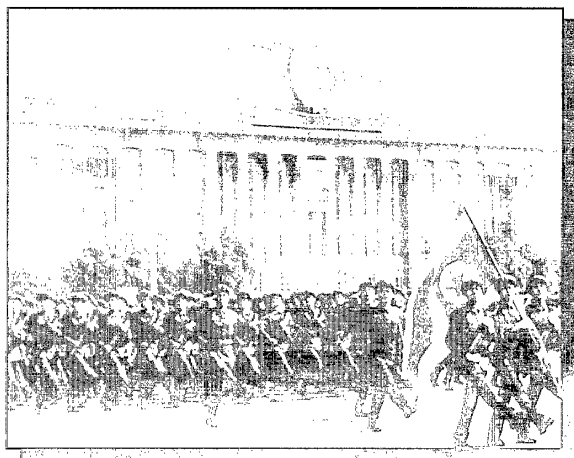


*T*HE NEW CONTEXT



Chief of Naval Operations Jeremy M. Boorda greets Commander-in-Chief of the Russian Navy Feliks N. Gromov.

The decline of the Soviet threat has not removed the challenges faced by naval strike warfare. The Navy must be prepared to respond to various **major regional conflicts** that could emerge around the globe. North Korea still poses a major military challenge in the Far East, and exemplifies a region in which conflict could occur.



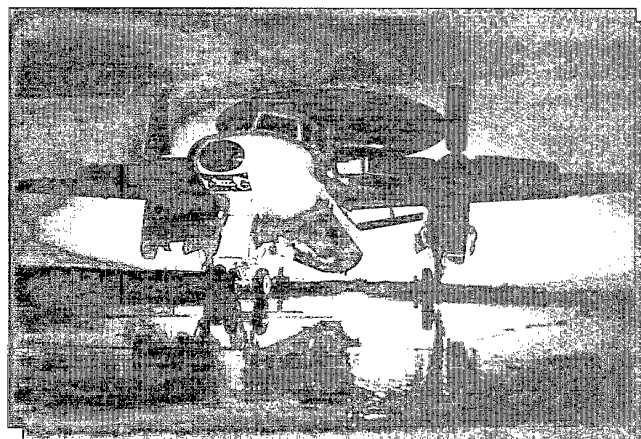
North Korean Military Parade

Rogue states or unstable nations are another example of where naval strike warfare could be tasked. State-sponsored terrorism or threats to U.S. citizens or diplomats often fall in the rogue state category.



The wreckage of PAN AM 103 after terrorist attack.

The Navy, by virtue of its forward deployed posture, is well equipped to monitor and respond to **international arms proliferation** or **transnational criminal activity**. United States naval forces are particularly effective in monitoring and enforcing United Nations arms embargoes or detecting and reporting on narcotics smuggling.

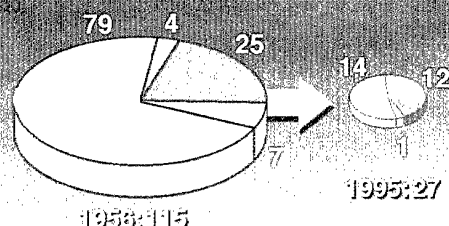


E-2C HAWKEYE Radar Surveillance Aircraft

So while the prospect of global conflict has receded, the myriad challenges facing the nation still demand potent naval strike warfare forces, deployed forward and ready to respond to policy makers' requirements.

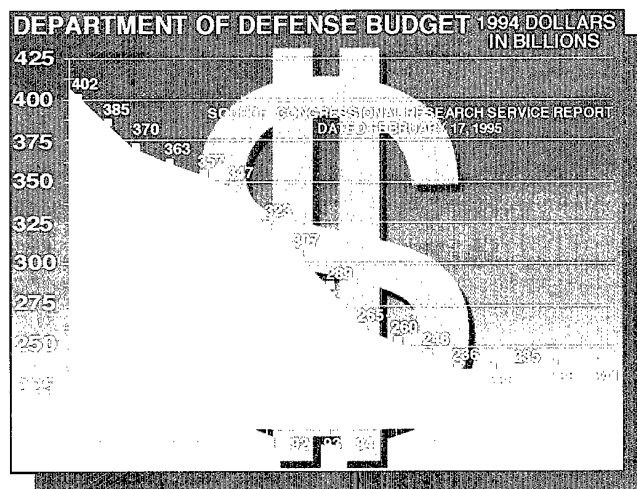
T HE NEW ENVIRONMENT

MAJOR OVERSEAS BASES



Declining U.S. Air and Naval Bases

Political, environmental, budgetary, and military factors have conspired to dramatically reduce the number of U.S. operated overseas bases.



The Declining DoD Budget

The U.S. Navy has undergone requisite budget cuts in recent years. These cuts have forced the Navy to meet additional challenges with fewer resources. Strike forces play an important role in this capability.



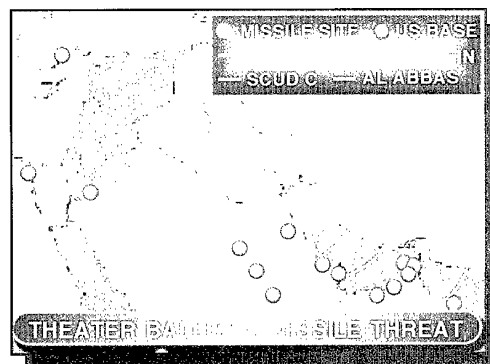
Islamic Demonstration

The rise of nationalism, transnational movements such as Islamic fundamentalism, and strained alliances have changed the world political landscape. The ability of naval strike forces to remain near world crisis points for extended time periods is growing in value.



Marine coming ashore in Somalia, 1993.

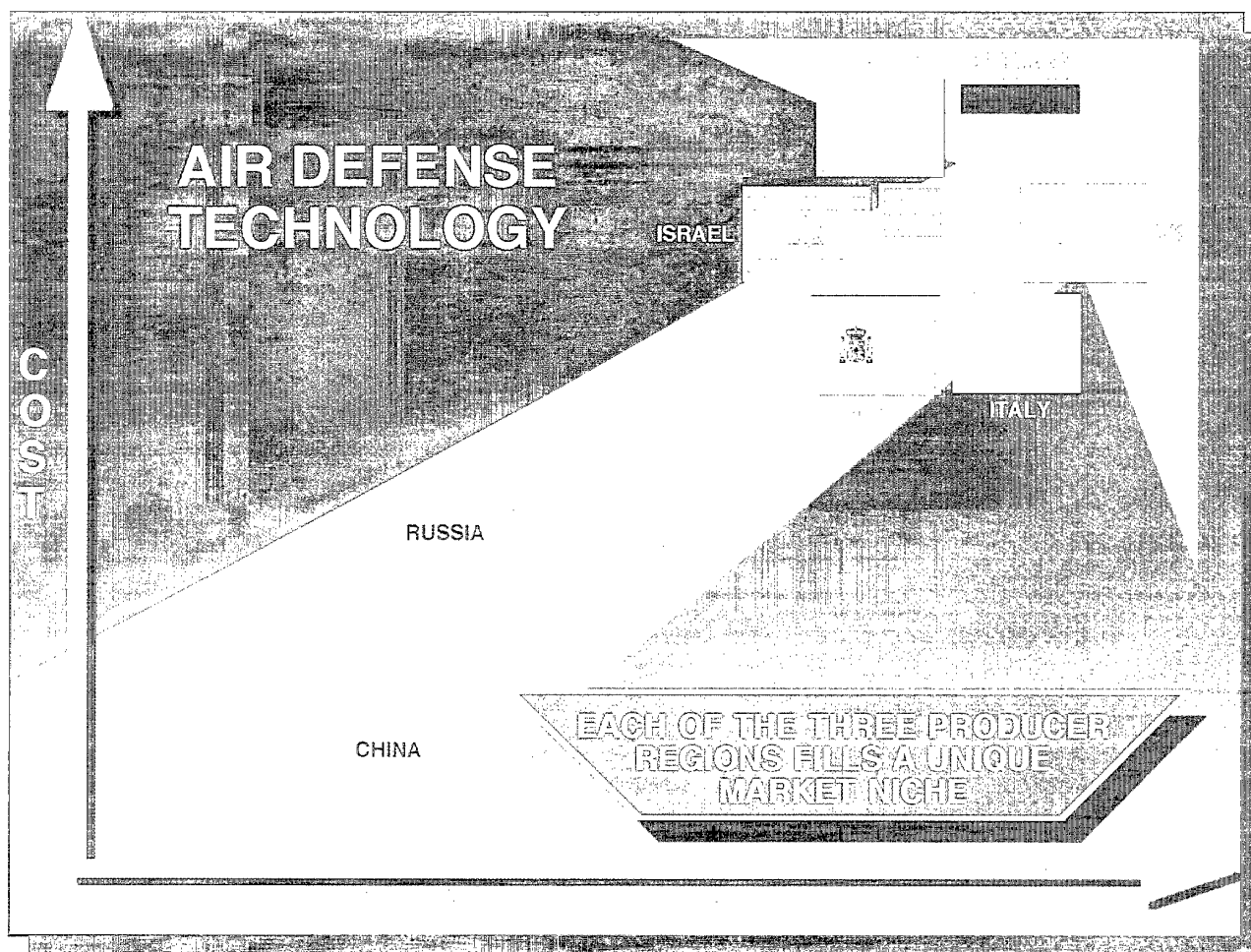
From the traditional media to the internet, the world is experiencing an information explosion. Military operations will be conducted with worldwide, real-time media coverage.



Tactical ballistic missile coverage in the Persian Gulf.

The world's military forces have embraced the importance of precision-guided weapons. As these weapons enter its forces in numbers, they will alter the littoral environment in which U.S. naval forces operate.

CHALLENGES OF PROLIFERATION TODAY



Air defense technologies span the spectrum of cost and capability.

The face of future conflicts has been dramatically altered by the spread of high technology systems. Regional powers are responding to the lessons of recent military actions including advanced tactics, night and adverse weather operations, information warfare, and the importance of stand-off and precision-guided weapons. In many cases, the West itself is the primary supplier of new military technologies that Western forces may face in combat. The integration of new electronics, a Western strength, appears

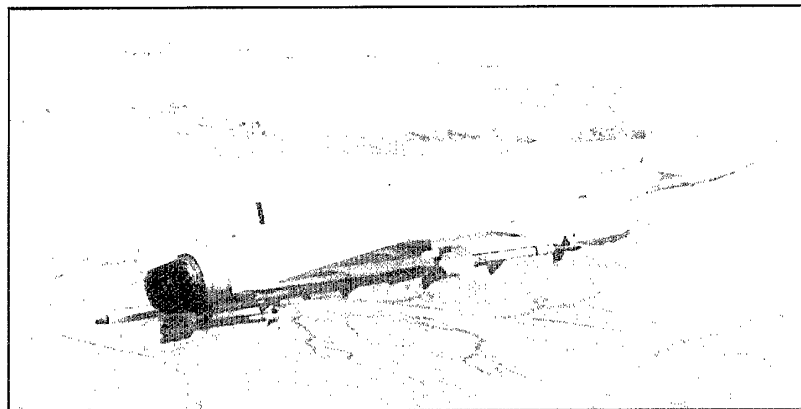
to offer the most leverage for future air and air defense systems. Proliferation of these concepts can occur through direct foreign military sales or through transfer of technologies that aid indigenous development programs.

Medium to low cost alternatives are being offered by Russia, China, and other suppliers. In the case of Russia and China, these sales offer a source of hard currency to continue weapons development and procurement.

THE BUILDERS: THE WEST - LEADING EDGE TECHNOLOGIES

**HIGH TECH. . .
MULTINATIONAL. . .
LARGE INVESTMENTS. . .**

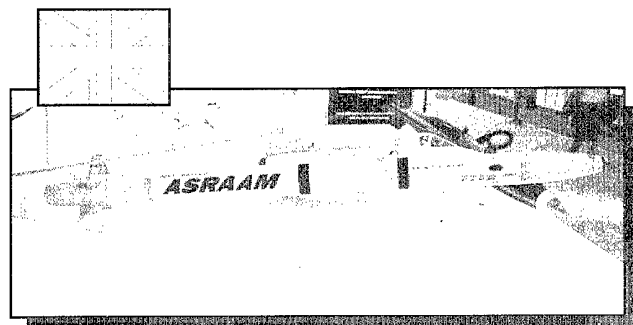
EUROFIGHTER 2000



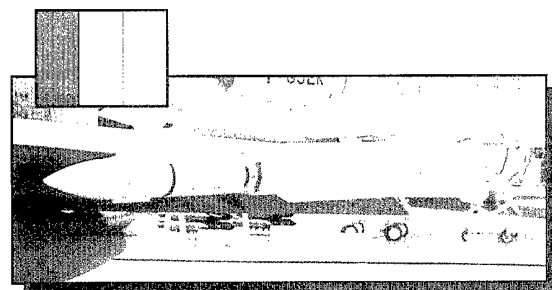
Western industry leads the world in terms of level of sophistication and combat effectiveness of aerospace equipment. Market trends after the collapse of the Soviet Union show that systems of Western origin are preferred by most militaries despite higher cost. Manufacturers will continue to look to export sales to help defer the extremely high cost of developing new aircraft and surface-to-air missile systems. The growing importance of export sales combined with a shrinking market will increase competition among vendors. This, in turn, may lead to early export of top-of-the-line systems rather than sales of downgraded or older generation weapons.

The West is developing a number of advanced aircraft-related technologies. Long range offensive combat will be aided by sophisticated multi-mode radars and complementary active radar missiles. Integrated, automated countermeasures suites will improve defensive capability. Close combat improvements include agile fly-by-wire configurations, coupled with helmet-mounted aiming systems and advanced infrared missiles.

Western SAM developments include increased mobility and survivability. Advanced technology missile seekers will enhance system lethality by using new portions of the electronic spectrum and incorporating multi-mode designs.



ASRAAM Dogfight Missile

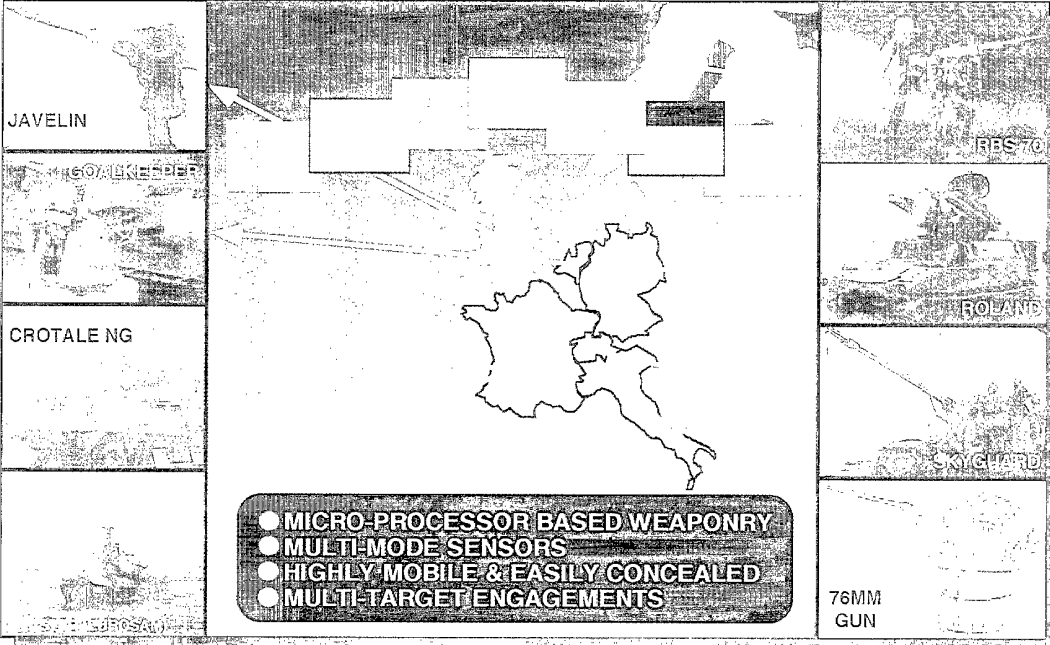


Medium Range Matra MICA

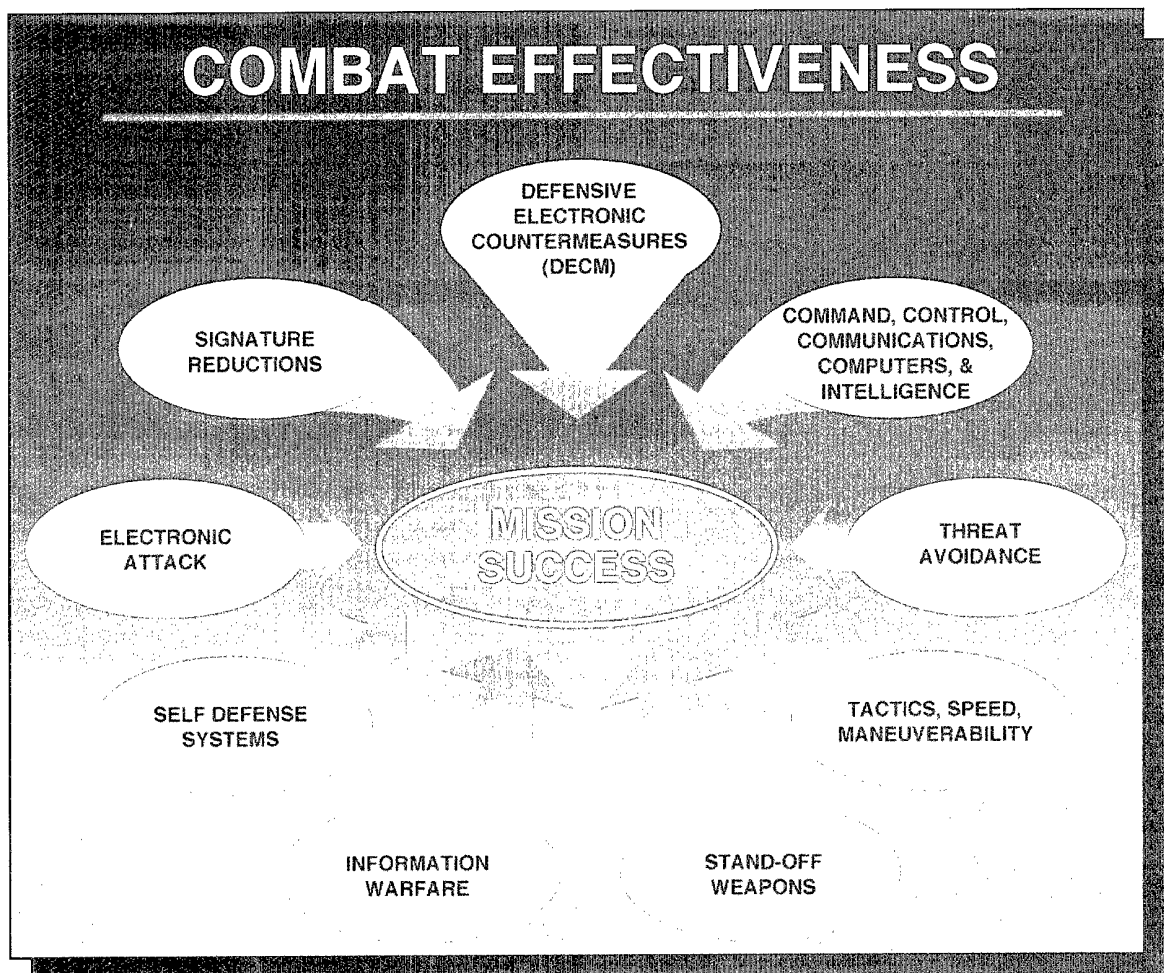
IGH TECHNOLOGY WEAPONS MARKET



The United States and other aerospace industrial powers look to foreign sales to help maintain their manufacturing base.



SYNERGY OF TECHNOLOGY



The explosion in cost and complexity of strike warfare systems has forced militaries of the world to accept the fact that they can no longer afford to maximize a weapon system's performance across the entire spectrum of characteristics. Instead, finding the optimum blend of features to maximize mission effectiveness while at the same time holding costs at a reasonable level has become the primary goal of many weapons development programs. These boundaries on the development of strike warfare systems have increased the need for a synergistic approach to the development of aircraft and cruise missiles. Although some technologies such as long range cruise missiles, countermeasures suites, and reduced signatures have the potential to dramatically effect mission success, it is not feasible to build affordable systems that rely entirely on one key technology to achieve their objective.

The trend toward well balanced systems is typified by the new generation of multi-role fighter aircraft under development in Europe, Russia, and China. These aircraft must be able to handle a variety of tasks, from air-defense to reconnaissance to ship attack. In order to meet this wide range of missions, they carry capable avionics systems for electronic attack, defensive electronic countermeasures, information warfare, threat avoidance, and command and control. Other common features of this generation of fighters are reductions in aircraft signature, increased aircraft agility, and ability to fire sophisticated stand-off weapons at both air and surface targets. Although not cheap, the synergistic blend of systems and capabilities within these aircraft provides a cost effective capability across the entire range of anticipated challenges.

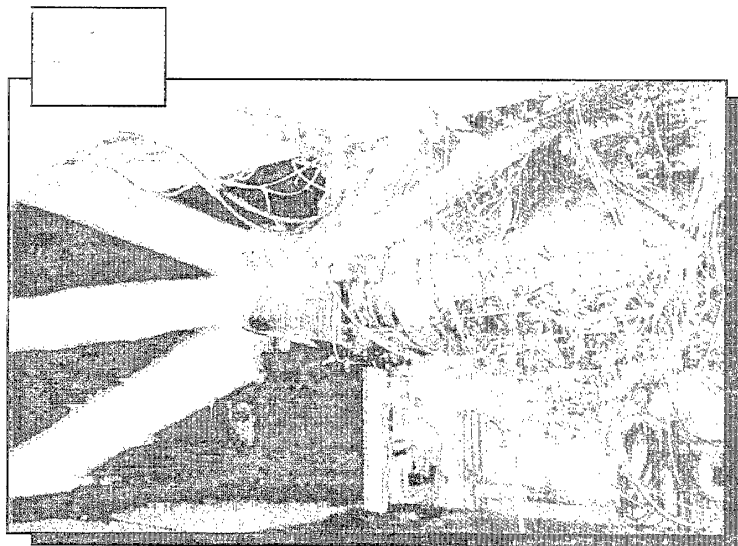
KEY LEVERAGING TECHNOLOGIES: FLIGHT PERFORMANCE AND PROPULSION



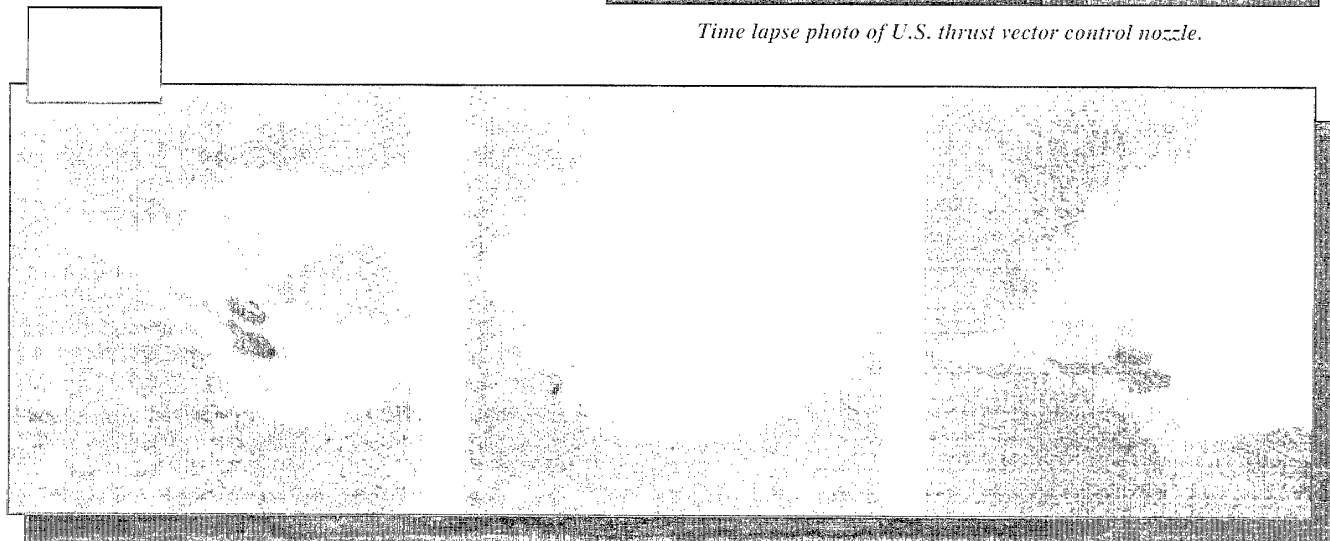
JAS-39 GRIPEN

Future fighter powerplants will incorporate higher thrust-to-weight ratios, and possibly thrust vectoring for aircraft control. Digital engine controls will increase engine responsiveness, fuel efficiency, and resistance to stall.

Next generation fighter aircraft will have outstanding maneuvering performance and agility, relying on unstable delta wing and canard configurations. Russia currently demonstrates the remarkable agility of their aircraft with the famous "Pugachev Cobra" and "Hook" maneuvers. Although of questionable combat utility today, these maneuvers are testimony to excellent aerodynamics and engine integration. In the future, coupled with thrust vectoring, these types of maneuvers could dramatically increase an aircraft's potential dominance in a dogfight.



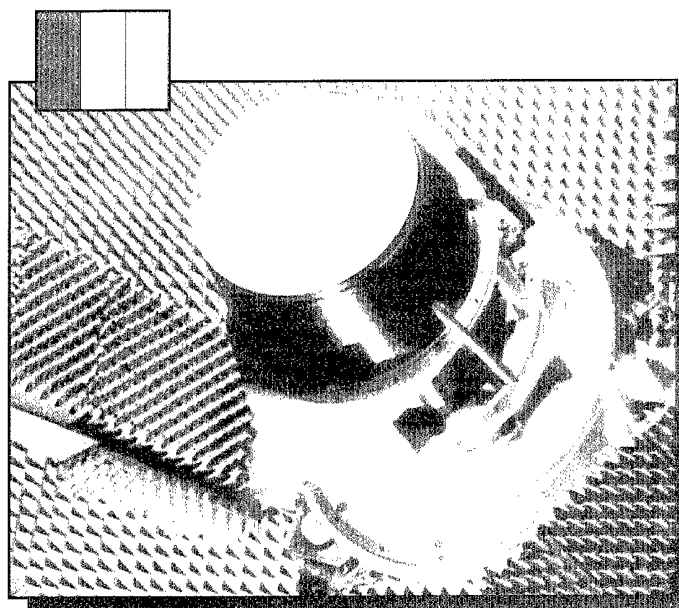
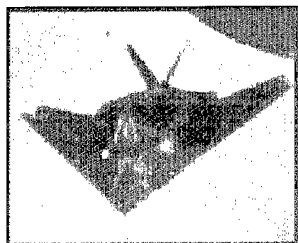
Time lapse photo of U.S. thrust vector control nozzle.



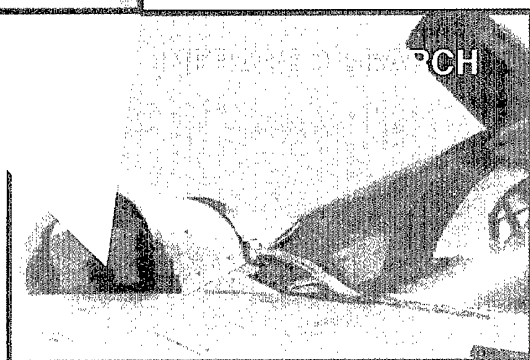
Russian aircraft have demonstrated considerable agility.

FIRE CONTROL SENSORS

The current trend in fighter radars is to incorporate true multi-mode, multi-function, and multi-target capability. Additional improvements include dramatically increased onboard computer-power, electronic scanning antennas, low probability of intercept operation, and increased reliability.



The RBE-2 radar in test.



Infrared search offers an alternative to radar.

Infrared search and track (IRST) systems are beginning to exploit the 8-14 micron band of the infrared spectrum. The signature of the aircraft in this band is derived from friction-induced skin heat and is hard to conceal. Although design of a reliable system in this band poses technological challenges, there is potential to detect low radar signature targets.

Uniquely, Russia is pursuing expanded radar azimuth coverage

EVOLVING RADAR COVERAGE

1985



INTERCEPT
RADAR ONLY



LIMITED
TAIL DEFENSE



OVERLAPPING
COVERAGE ZONES

IGNATURES

4. "The number of groups" = 2 "groups" (individuals, couples, etc.)



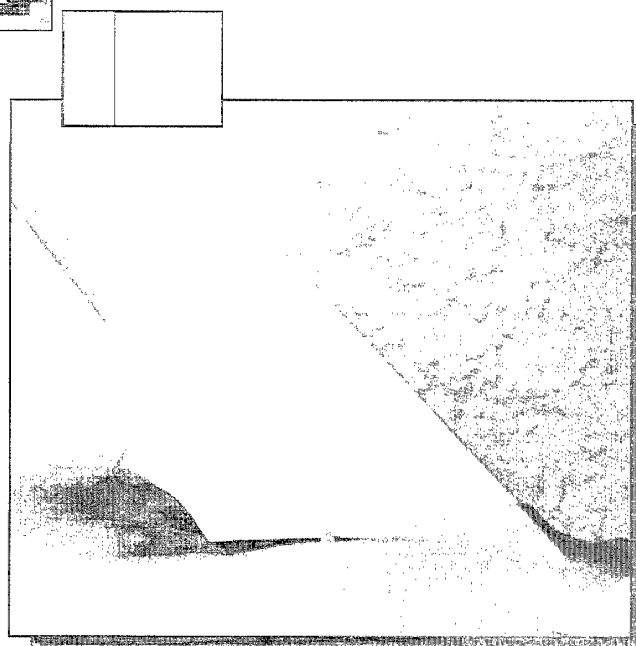
The United States leads the world in stealth technology, followed by the United Kingdom, France, Germany, and Israel. Russia is developing its first fighter with a low radar cross-section and exporting treatments for fielded airframes. China is researching stealth applications and is likely to incorporate this technology in future aircraft.

Every fighter in design today has a requirement to control its signature, particularly against radar. Today's combat aircraft can be treated with radar absorbing materials to achieve reasonable results for a moderate price.

STEALTHINESS is....
A FORCE MULTIPLIER
A TECHNOLOGY DRIVER
BUT....
PERISHABLE.

Few nations will have the economic resources to buy true stealth aircraft; therefore, designs will concentrate on reducing radar returns in key regions around the vehicle.

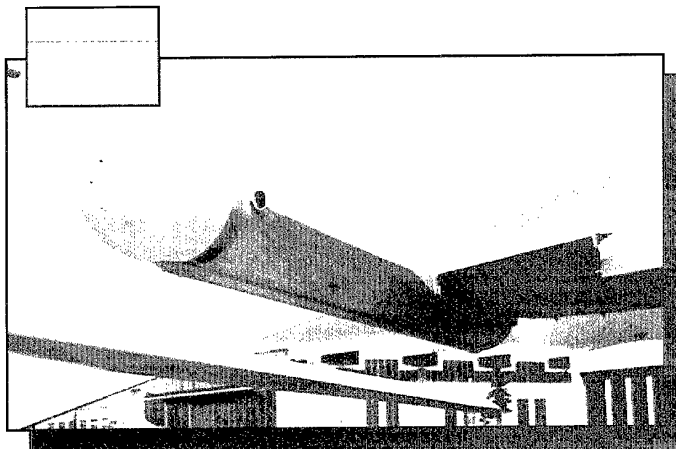
At the same time, many of these countries are pursuing technologies to counter targets with reduced signatures.



Sawtooth radar absorbing material on RAFALE.

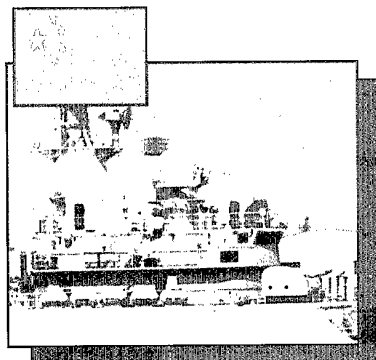
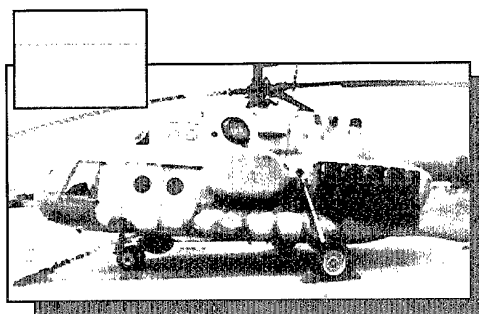
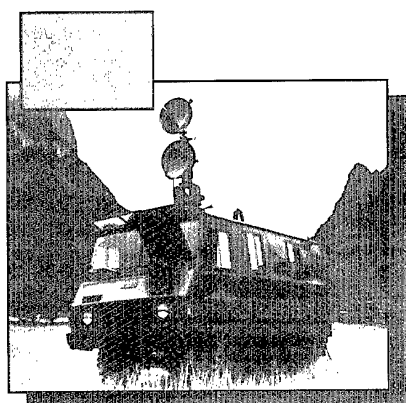
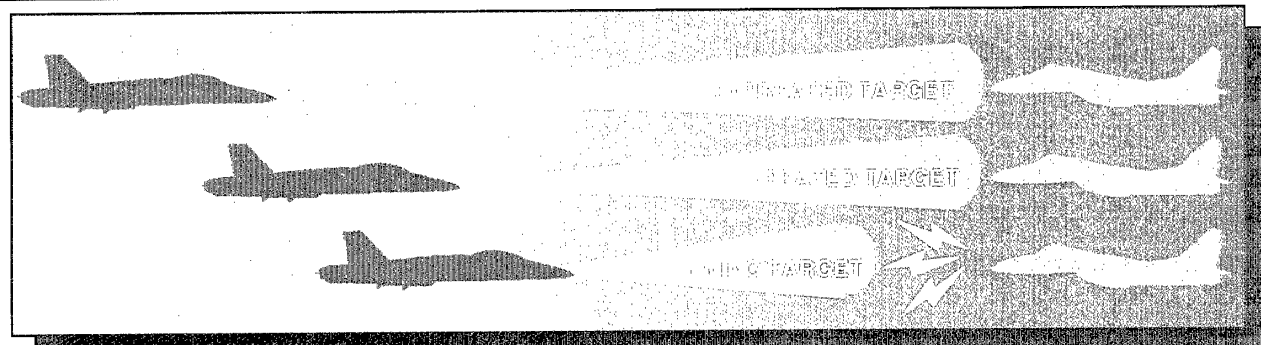
JAMMERS AND COUNTERMEASURES

Future fighter survivability goals can be met through a balanced application of stealth and electronic countermeasures. Low radar signature improves the effectiveness of jammers by reducing the amount of power required to conceal the aircraft. Fighters will have moderate radar signature reduction coupled with very capable and sophisticated countermeasures. Russia and France can be considered the world leaders in airborne jammer technology today, and continue to develop advanced systems.



Russian electronic warfare pod on an Su-30MK.

Both signature reduction and jamming can be used to achieve similar results by denying intercept information, compressing intercept timelines, and reducing shot opportunities.



(Clockwise from the left) The Chinese Model 974-1 radar jammer (from a British design), the Russian HIP H communications jammer, and the Chinese NRJS radar jammer (from a Dutch design).

Field commanders have recognized the value of electronic attack both on the offensive and defensive side of the battle line. Air-, sea-, and land-based counterstrike jammer platforms are proliferated by numerous countries and are an integral part of their warfare doctrines.

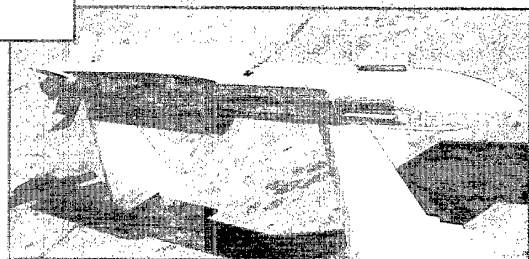
Future electronic attack systems will attempt to deceive or deny navigation and targeting information to aircraft and weapons.

AIR - TO - AIR WEAPONS

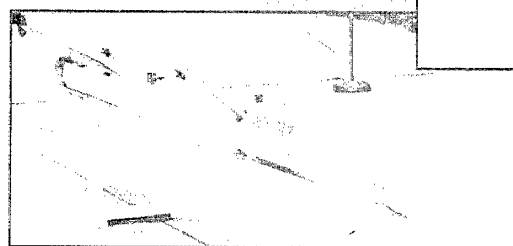


Russia's 200-mile AAM-L concept.

Extremely long range missiles are a unique Russian development. The Russians believe that weapons systems should engage targets near maximum sensor range. Likely high value targets include heavy bombers, the E-2C HAWKEYE, AWACS, or JSTARS.

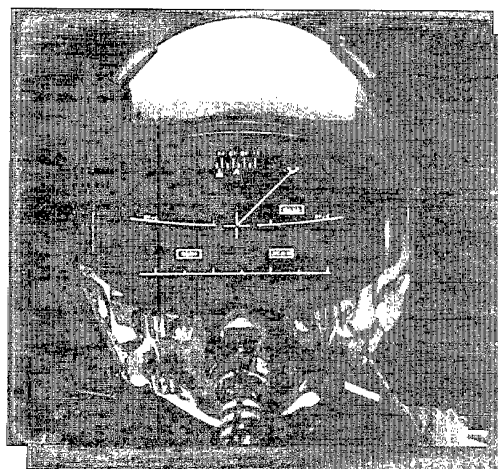
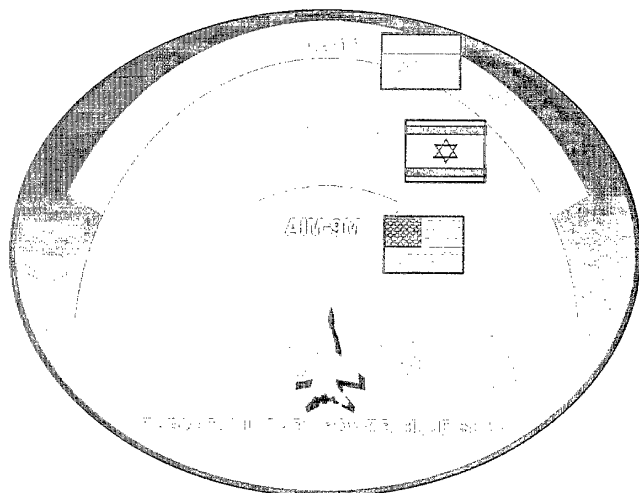


(Clockwise from the far left) The MICA, AA-12, and AA-10 missiles.



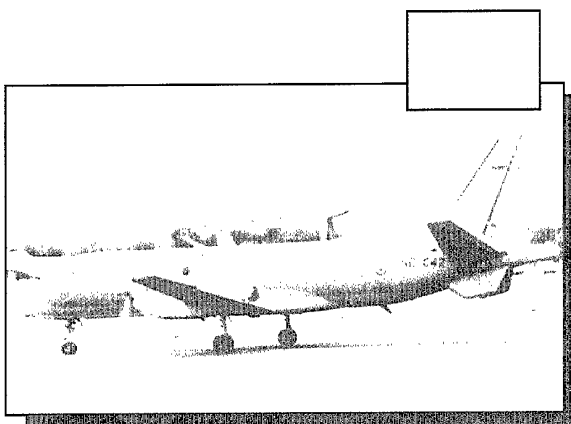
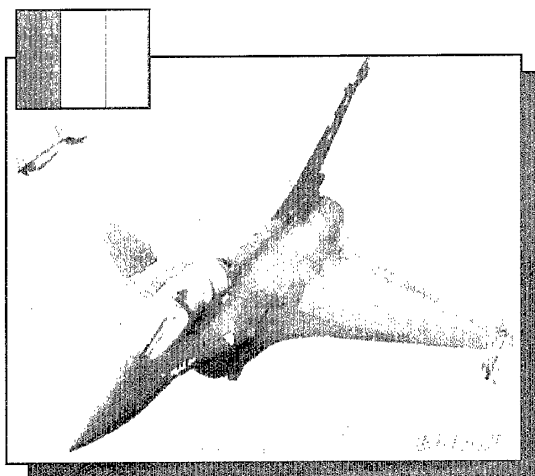
The major trend in medium range missile development is the use of active radar seekers with launch-and-leave capability. Numerous programs are already well into their development cycle including the Russian AA-12, AA-13, and AA-10 active variants, as well as the French MICA AR. Russia is considering a rocketramjet version of the AA-12 which could increase its range to over 60 nautical miles.

The Russian AA-11 and Israeli PYTHON 4 define the leading edge of dogfight missiles. Integrated with a helmet-mounted sight, these weapons can fire at targets approaching 90 degrees off the fighter's nose. Future missiles will also increase firing range, provide lock-on after launch capability, and employ imaging sensors that will reject countermeasures.

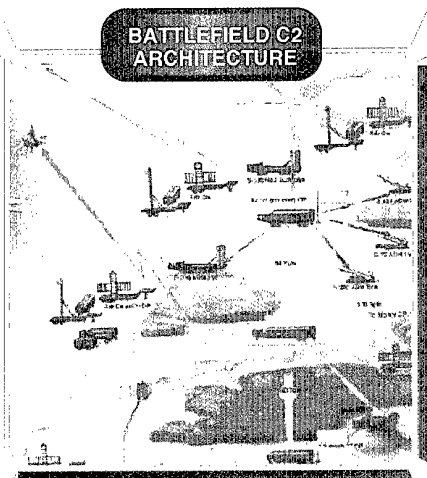


Helmet-mounted Sight

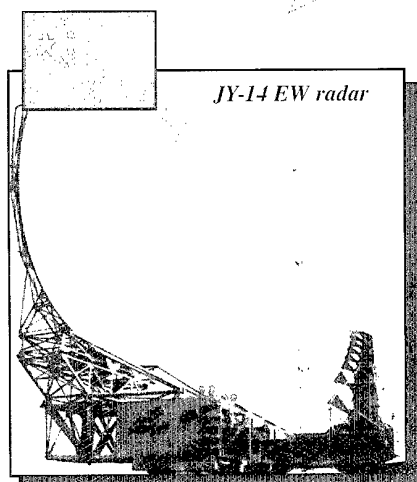
COMMAND AND CONTROL



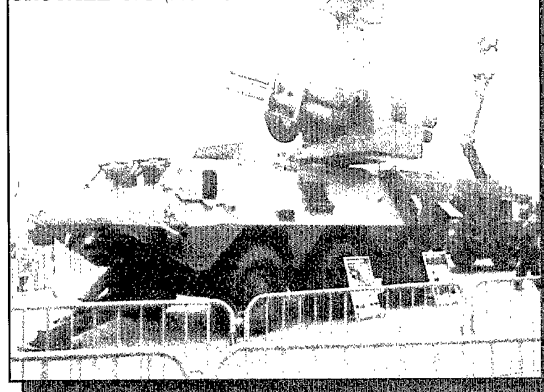
The individual components of an air defense net must be able to effectively interoperate. Modern high-speed command and control architectures of Western design are preferred due to their processing power and flexibility. These systems allow mix and match integration of diverse air defense elements, eliminating the need to purchase a complete air defense complex from the same supplier.



Command and control systems, with their ability to integrate inputs from myriad active and passive sensors, offer the greatest potential to counter stealthy vehicles. With sufficient processing power, an air defense command and control node may be able to combine seemingly insignificant data from numerous surveillance sites into an engageable target track.

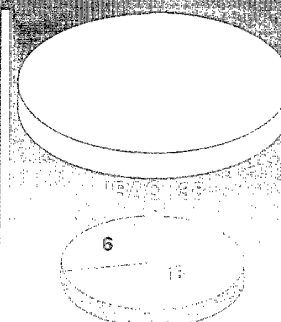
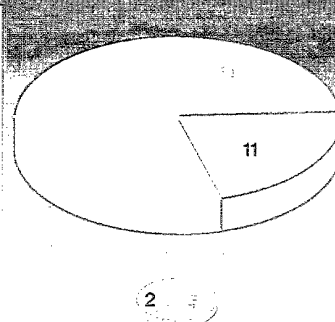
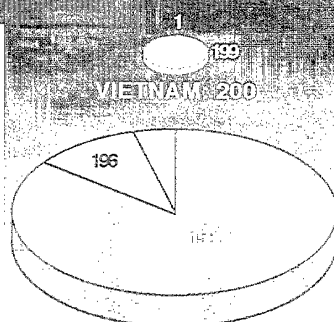
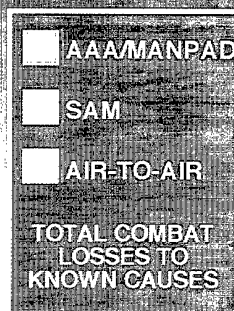


CROTALE NG (New Generation)

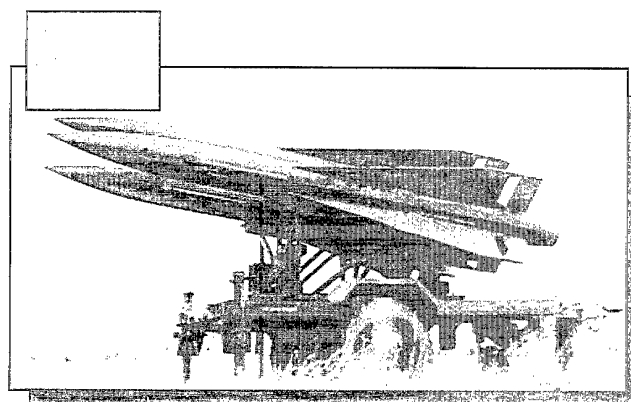


SURFACE - TO - AIR WEAPONS

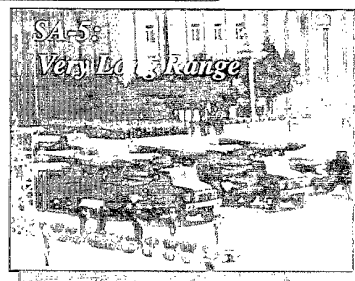
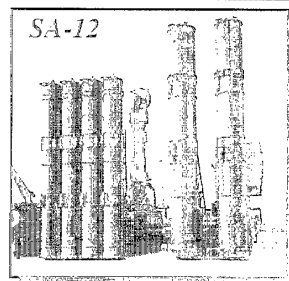
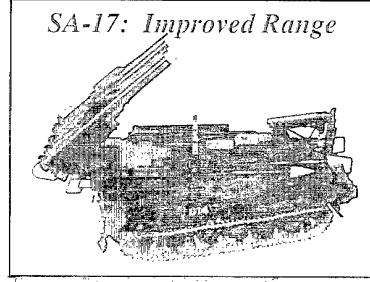
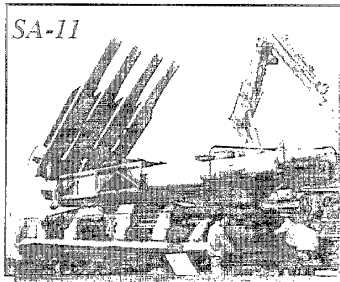
LOSSES TO AIR DEFENSE SYSTEMS



Modern U.S. and Allied strike aircraft combat losses are primarily due to surface-to-air missile (SAM) systems and anti-aircraft artillery (AAA)/man portable air defense systems (MANPADS) [10% and 85%, respectively, in the Vietnam War], while enemy fighter losses are from air-to-air engagements. The relatively low cost of ground-based air defense systems compared to tactical aircraft make them an attractive option; however, very large numbers must be fielded to dominate the same volume of airspace as a few sophisticated fighters.

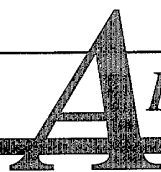


I-HAWK



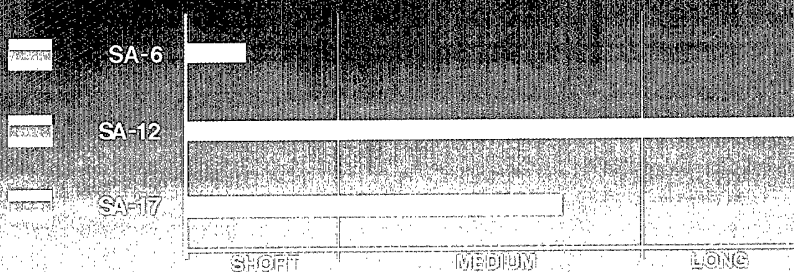
Today, Russia continues to lead the world in SAM design and proliferation. Programmed improvements in capability and electronic attack survivability keep their equipment at the forefront of sales. These systems provide overlapping coverage in range and altitude to defend against aircraft and low altitude cruise missile attack.

Future threats will span the range from low power lasers and directed energy weapons to larger caliber anti-aircraft artillery.



AIR DEFENSE WEAPONS TRENDS

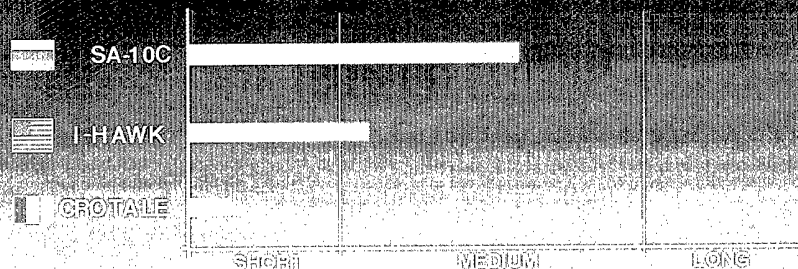
SAM VS STRIKE AIRCRAFT



ALTITUDE : 20,000 FT
SPEED : 9 MACH

A *wide variety* of surface-to-air missiles has been designed to counter aircraft. Systems range from fixed, long-range strategic units through highly mobile battlefield designs.

SAM VS CRUISE MISSILE



ALTITUDE : 100-300 FT
SPEED : 7 MACH

Most SAM systems have some capability to engage cruise missiles. The growing recognition of this threat has led to the design of specialized SAM systems to handle low flying, low signature targets. The Russian SA-10c is the premier system in the anticruise missile arena.

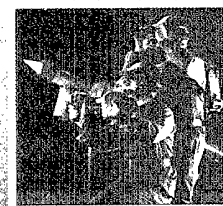


OLD

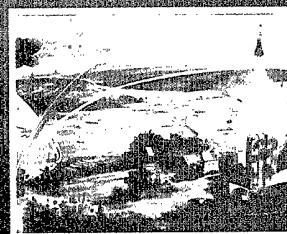


GREATER MOBILITY
MORE COMPACT
MULTIPLE TRACK/ENGAGE
MULTI-MODE SENSORS
FASTER / AGILE MISSILES
HIGHER FIRE RATES

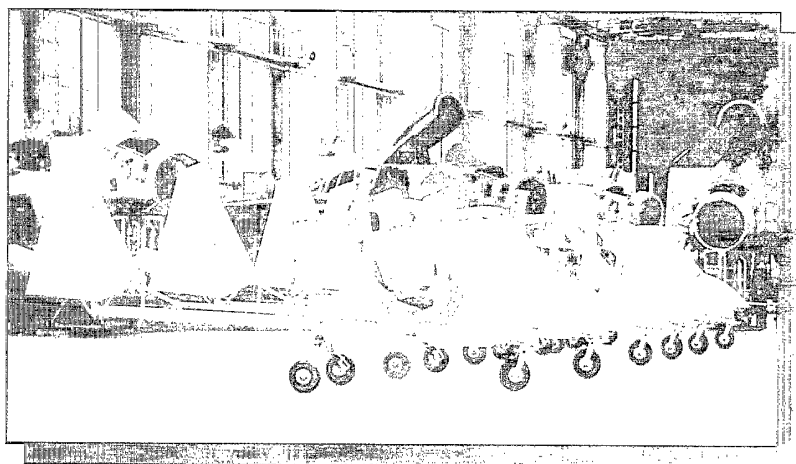
HARDER TO:
DETECT, DEFEAT, DESTROY
...DEADLIER FOES



NEW

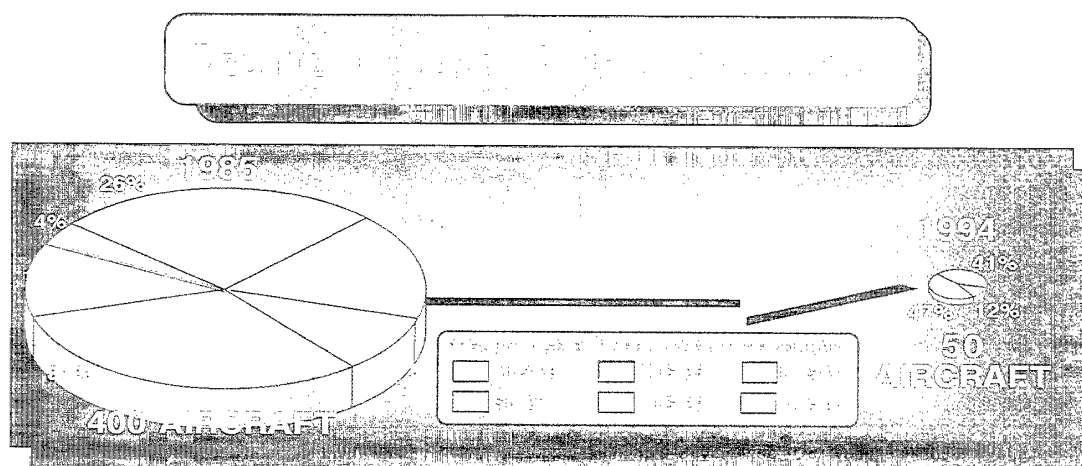


RUSSIA: STRUGGLING TO RETAIN SUPERPOWER STATUS

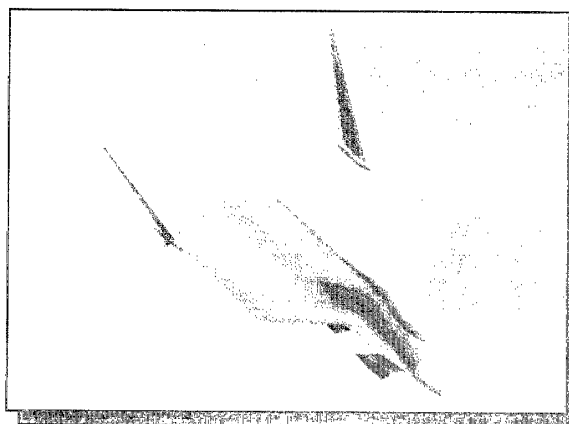


Ultralights Under Construction with MiG-29s in Moscow

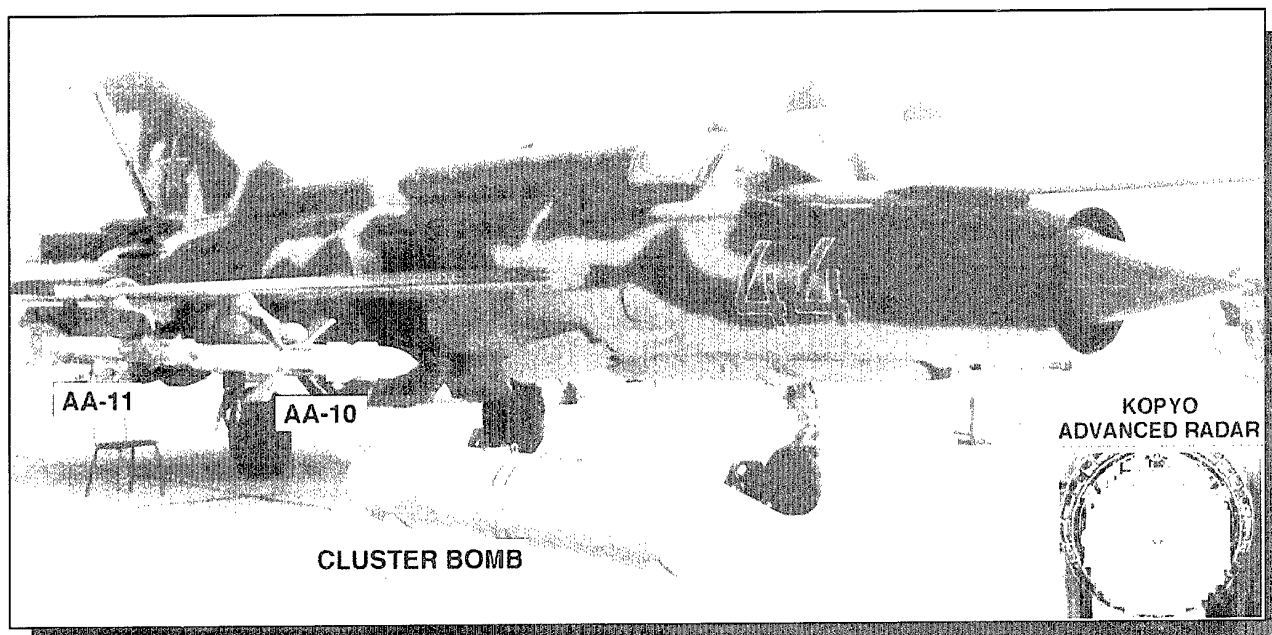
Russian aviation industry's fighter production has fallen over 85% since 1985, a decrease of approximately 9.5 billion U.S. dollars. Joint foreign ventures and cooperative civilian development are seen as a source of income through the lean years. Until the economy improves, the Russian Air Force will operate aircraft currently in service or upgrades to these designs.



Work continues on a much delayed fifth generation fighter (FGF), which could reach initial operating capability around 2015. In the near term, technologies developed for the FGF will begin to appear in advanced fourth generation fighters such as the Su-35. Export of the FGF, Su-35, or their subsystems to potentially hostile nations is of concern to defense planners.



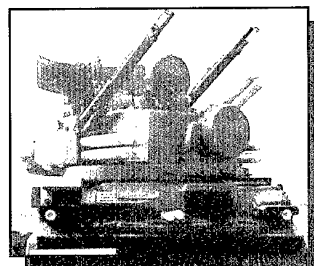
Russian Fifth Generation Fighter (FGF) model generated at the Office of Naval Intelligence.



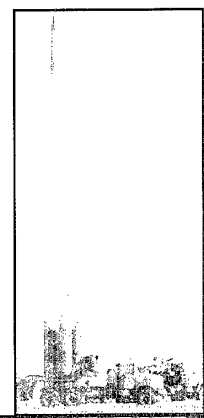
Prototype Russian MiG-21 Upgrade

Russia expects successes in the potentially lucrative worldwide fighter upgrade market with their MiG-21-93. Addition of the advanced, multi-mode KOPYO radar and AA-12, AA-10, and AA-11 missiles will give the second generation MiG-21 airframe near fourth generation weapons system capability at a fraction of the cost of a newly produced fighter.

Russian surface-to-air missile (SAM) systems range from widely proliferated man-portable units to extremely capable SA-10 long range radar-guided air defense systems. Their success selling these systems on the open market has been a valuable source of income.

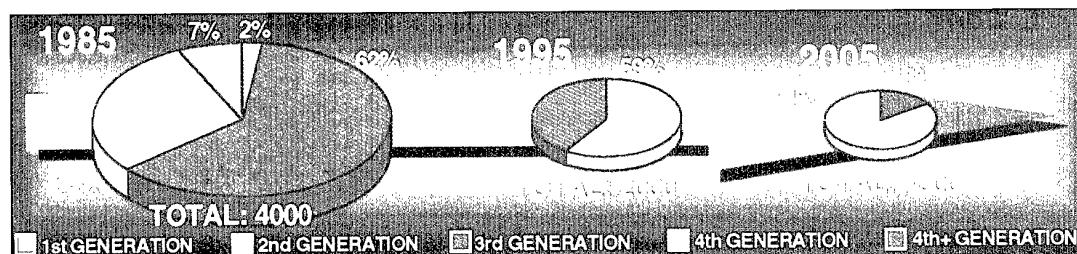


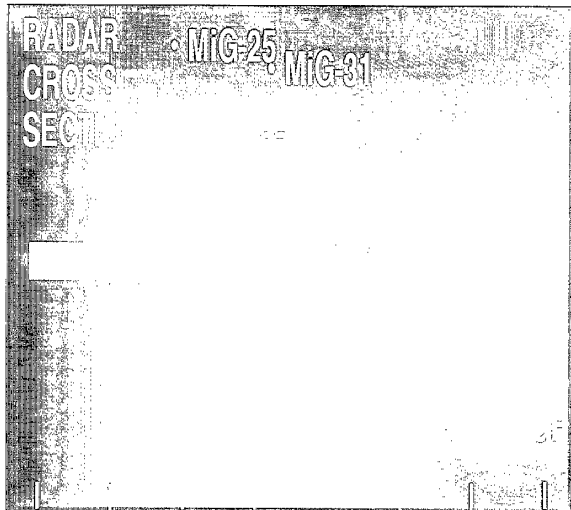
(Clockwise, from the left)
The 2S6
missile/gun
system, SA-10,
and SA-14



By 2005, the Russian fighter force (air force, air defense force, and naval air force) will be approximately one-third as large as its 1985 level. This striking reduction will be countered by dramati-

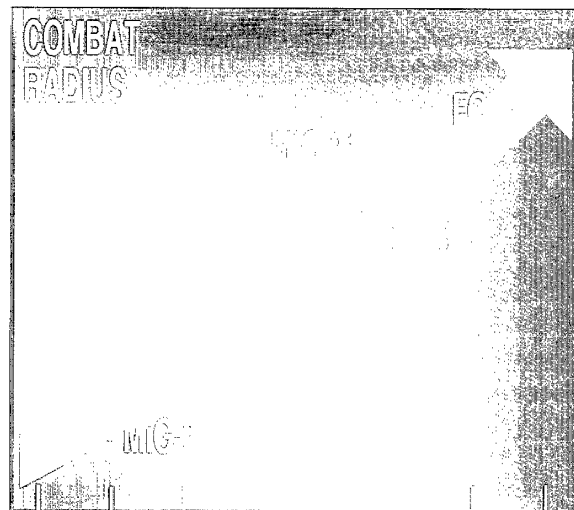
cally increased sophistication of the aircraft in service. The force may be composed entirely of fourth and improved fourth generation fighters.





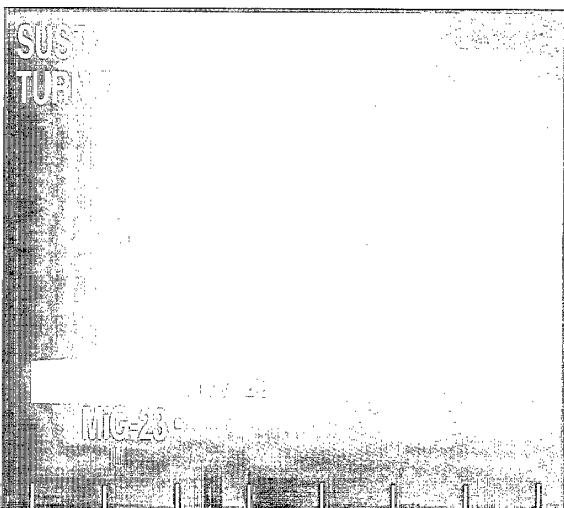
1950 1960 1970 1980 1990 2000 2010 2020

Russian industry sources have stated that their fifth generation fighter will be their first design to incorporate reduced radar signatures.



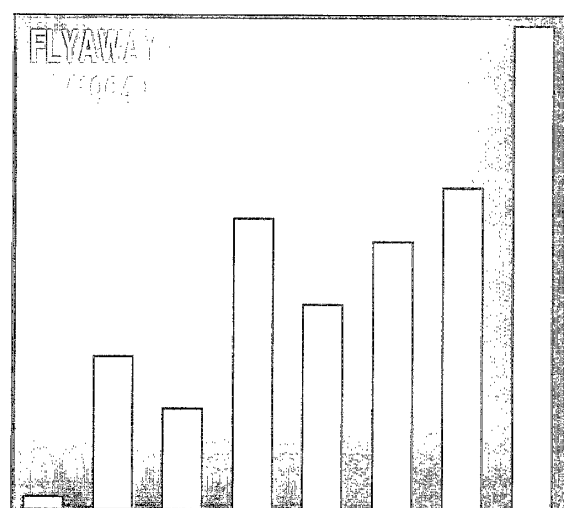
1950 1960 1970 1980 1990 2000 2010 2020

Russian fighters have paralleled the worldwide trend toward larger, longer range aircraft. The point defense MiG-29 is a notable exception to the rule.



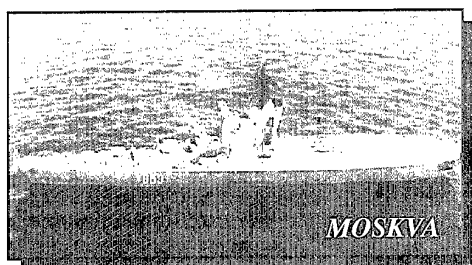
1950 1960 1970 1980 1990 2000 2010 2020

Fourth generation fighters like the MiG-29 and Su-27 re-emphasize maneuverability. The next generation will likely incorporate unconventional maneuverability in a quest for increased agility.

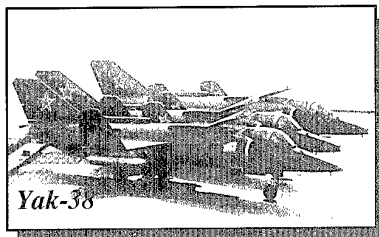


MiG-21 MiG-25 MiG-23 MiG-31 MiG-29 Su-27 Su-35 FGF

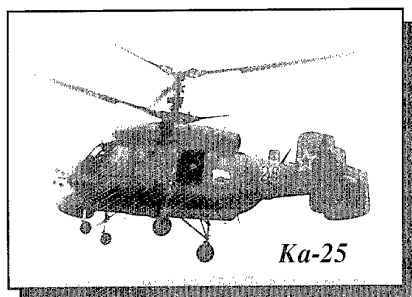
Although less costly than their Western counterparts, Russia's fighter designs have not been able to escape rapidly escalating prices.



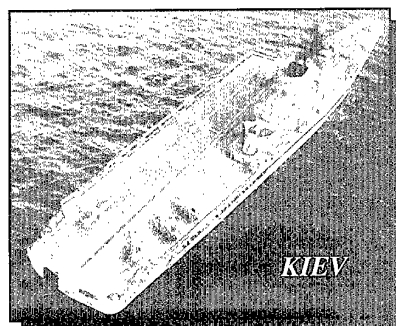
MOSKVA



Yak-38



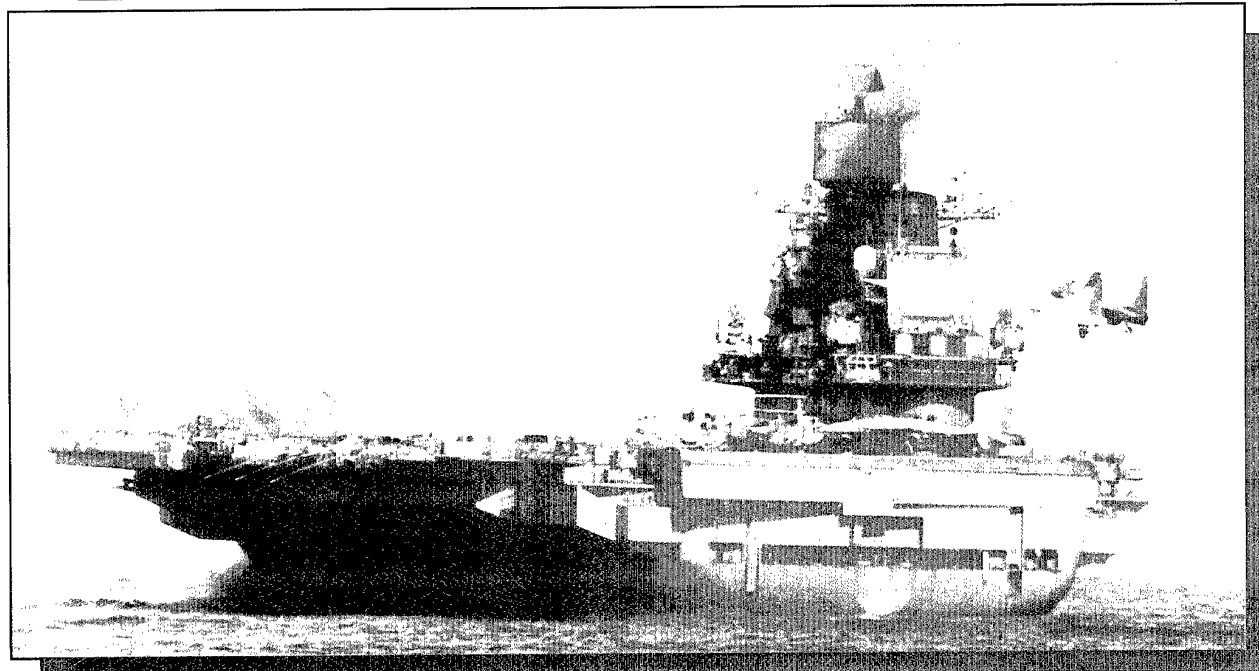
Ka-25



KIEV

Russia has been developing sea-based aviation for over 30 years. Early ships and airwings were the MOSKVA Class and its Ka-25 helicopter complement, and the KIEV Class and its Yak-38 attack aircraft. These units provided only a modest sea-based aviation capability.

RUSSIA OPERATES THE LARGEST CARRIER OUTSIDE OF THE UNITED STATES



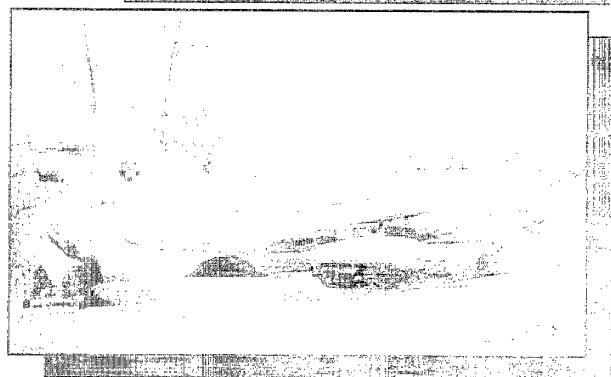
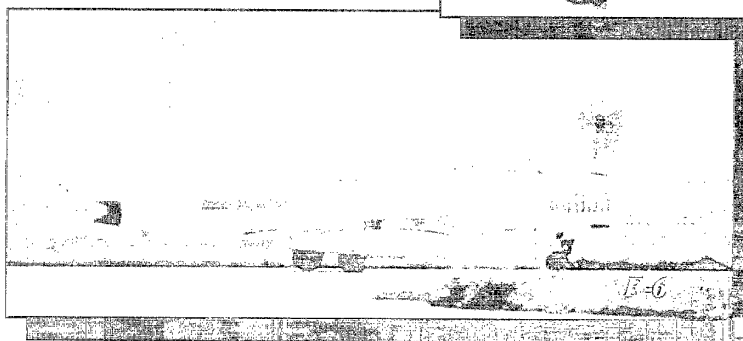
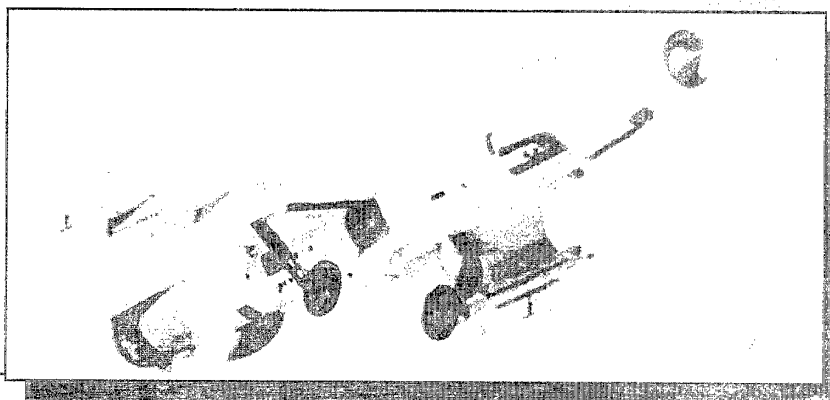
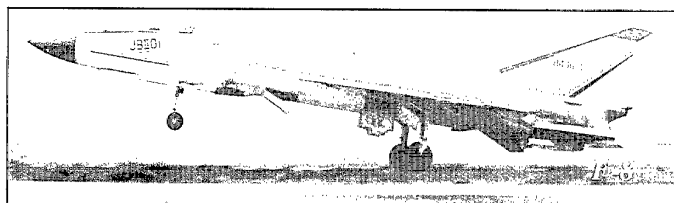
Su-27K on approach to the ADMIRAL KUZNETSOV

Russia's newest class of aviation ships is represented by a single unit, the ADMIRAL KUZNETSOV. It is the first Russian ship capable of operating modern multi-role fighters like the Sukhoi Su-27K. KUZNETSOV's airwing represents a dramatic improvement in sea-based air defense.

Russia retains its goal of developing a significant fleet of modern carriers and sea-based aircraft. The operational capability of their newest carrier, KUZNETSOV, was demonstrated in its early 1996 deployment to the Mediterranean.

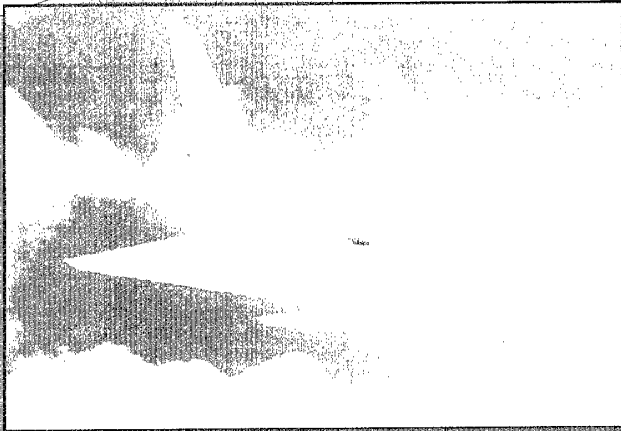
C HINA: TAKING THE TECHNOLOGY LEAP

China's indigenous designs are very simple and do not have great combat effectiveness; however, its aviation industry is gaining the required technologies to build first-rate aircraft. China has shown a willingness to spend some of its newfound wealth on advancing the industry's technological level with an eye toward eventual self-sufficiency. United States technology has been acquired through Israel in the form of the Lavi fighter and possibly SAM technology. Also, Russia's dire economic straits have given China an unexpected windfall of military aircraft technology.

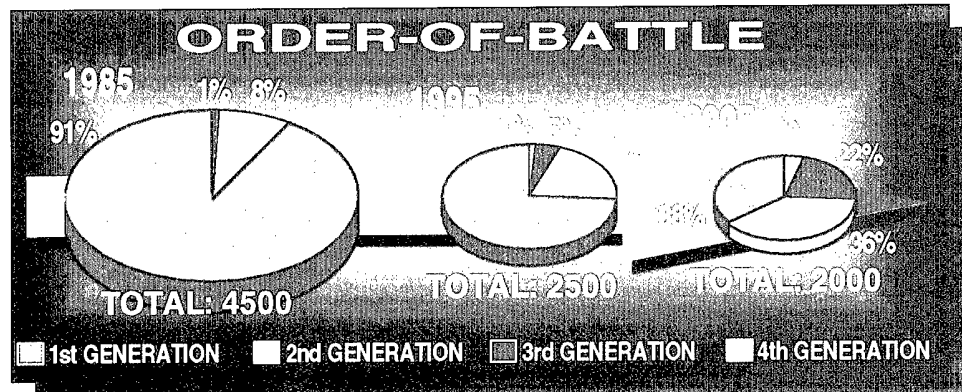


RECENT EXPORTS

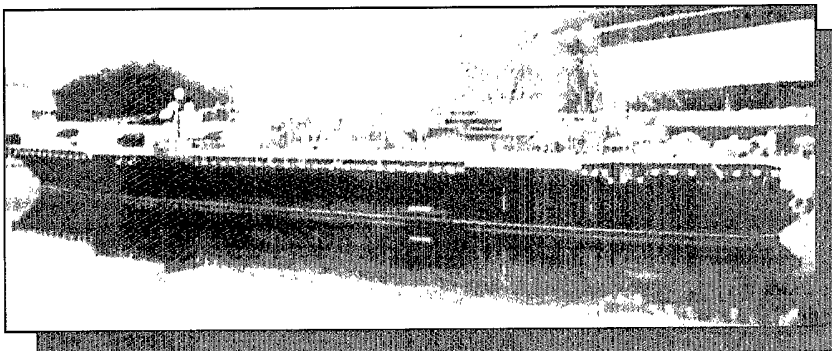
Recent exports have centered around the F-7, a Chinese-built version of the 1950's designed MiG-21. It fills a niche at the low end of the export market for inexpensive, albeit less capable, fighter aircraft.



China's air force is undergoing a reduction in numbers. In 1985, the force numbered over 4,300 fighters, but less than 1% were from the same generation as the U.S. F-4 PHANTOM II and over 99% were older. As China developed its fighter force modernization plans, they purchased 48 Russian Su-27SK fighters to bridge the gap until the indigenously built point defense F-10 enters service after 2000. The proportion of modern fighters in the force will grow to over 25%.



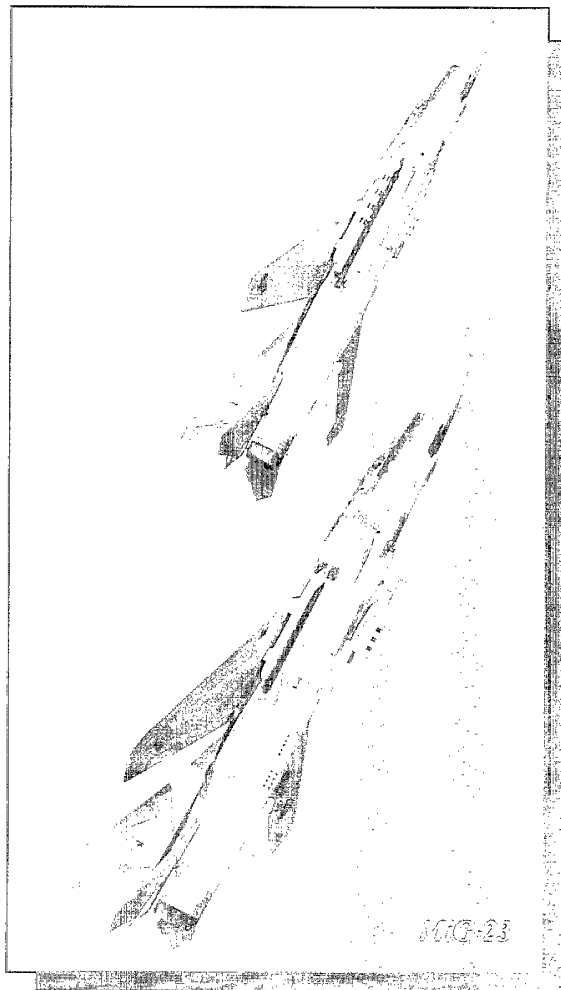
CHINESE CARRIER DEVELOPMENTS



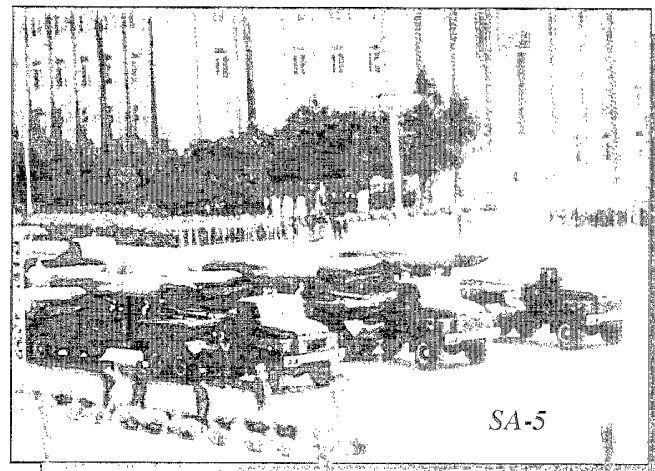
Chinese model of an aircraft carrier.

The Chinese Navy has given the development of aircraft carriers top priority. They are viewed as essential for Chinese enforcement of disputed territorial claims in the South China Sea. A report of the National People's Congress indicated that two 48,000-ton ships with a complement of up to 40 fixed-wing aircraft will be built by 2005. A number of fighters, including the new F-10, are being considered for at-sea basing.

THE BUYERS: NORTH KOREA - LIVING IN ISOLATION

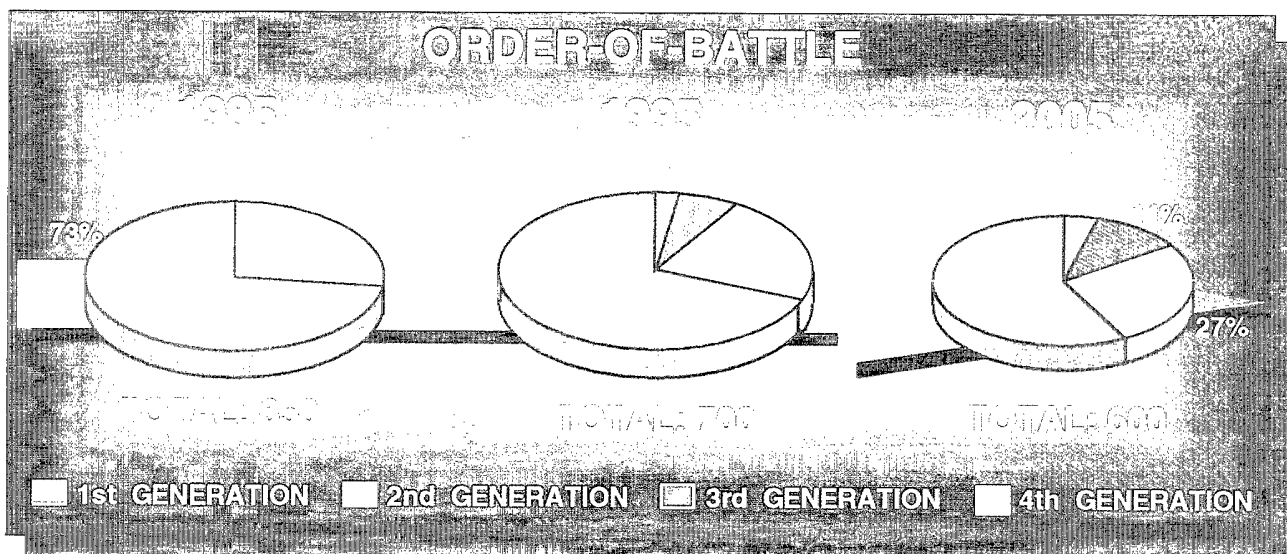


North Korea's air defense purchases include third generation MiG-23 aircraft, long range SA-5 surface-to-air missiles, man-portable air defense infrared missile systems, and various anti-aircraft artillery. Aircraft buys also include 15 fourth generation MiG-29s and AA-10a radar missiles from Russia. The most capable SAM purchased is the very long range SA-5.



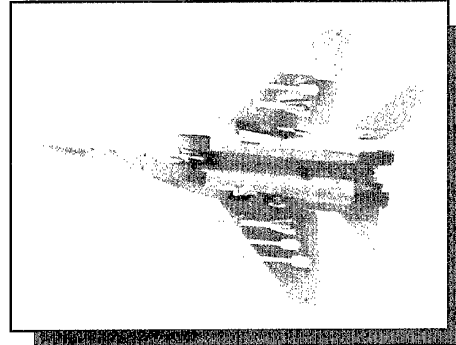
North Korea will continue to rely heavily on anti-aircraft artillery. Their efforts to continue modernization will be hampered by their poor economy and increasing political isolation.

ORDER-OF-BATTLE

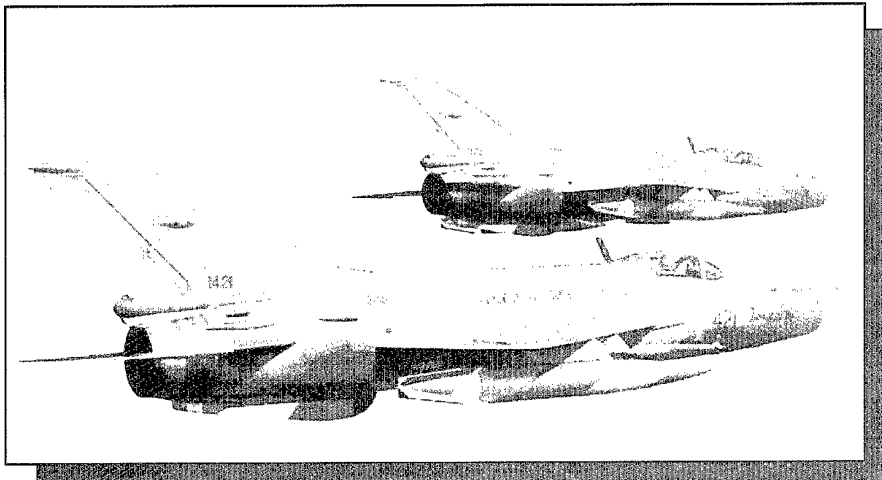


IRAN: CONTROL OF THE PERSIAN GULF

Iran is actively upgrading its air defense capability. They turned to Russia for high end systems and to China for simpler, cheaper platforms. Recent purchases include the MiG-29 with AA-11 and AA-10a missiles, the F-7 fighter, and SA-5 SAMs. Iran also holds a number of Iraqi aircraft from the Gulf War and has integrated some of them into its own air force.

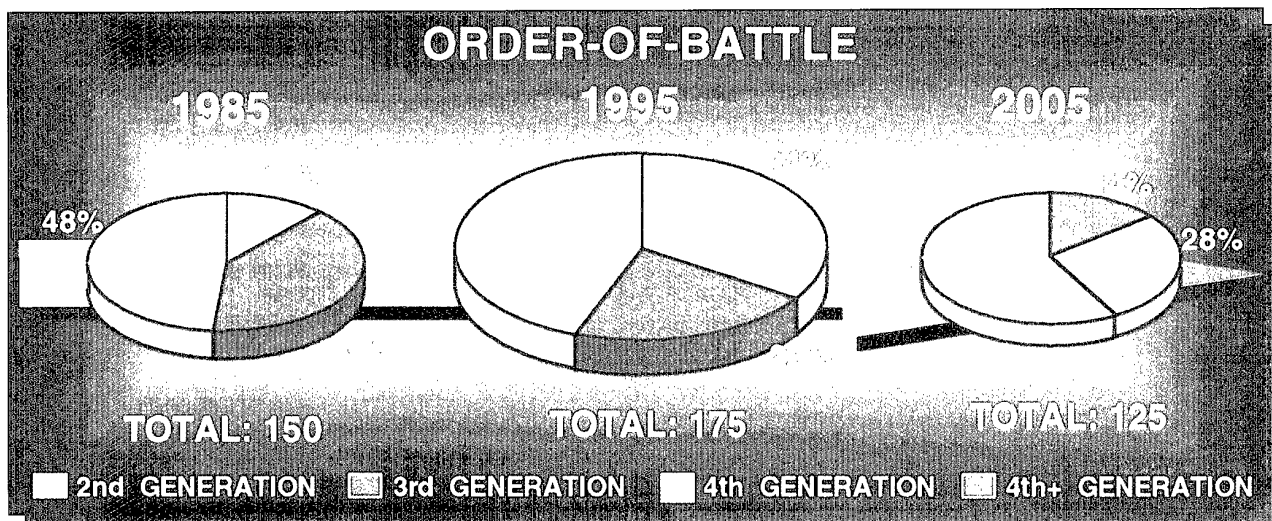


MiG-29



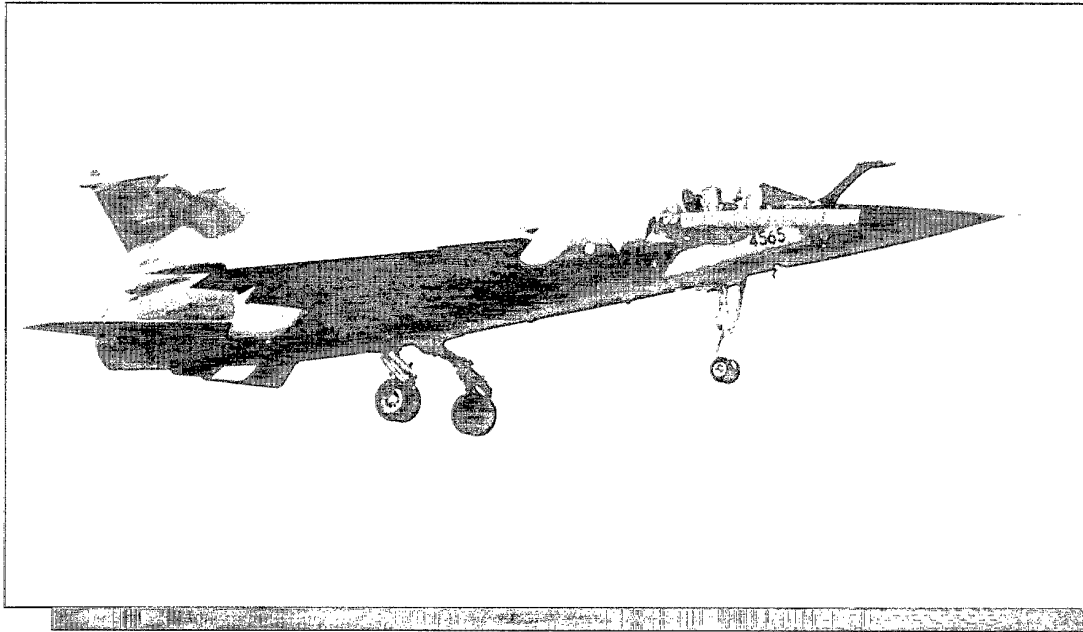
Chinese-built F-7

Iran will continue to slowly modernize its forces despite a weakening economy. In the future they could be pushed farther by a resurgent Iraqi military build-up.

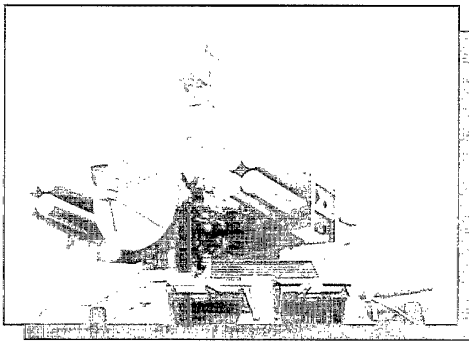


I

RAQ: REBUILDING HEGEMONIC ASPIRATIONS



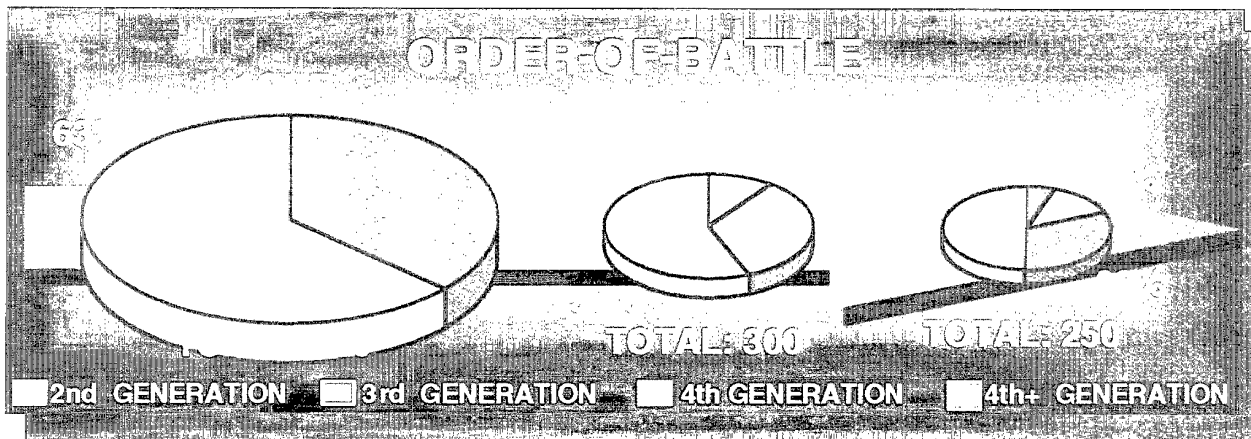
Dassault MIRAGE F-1 EQ



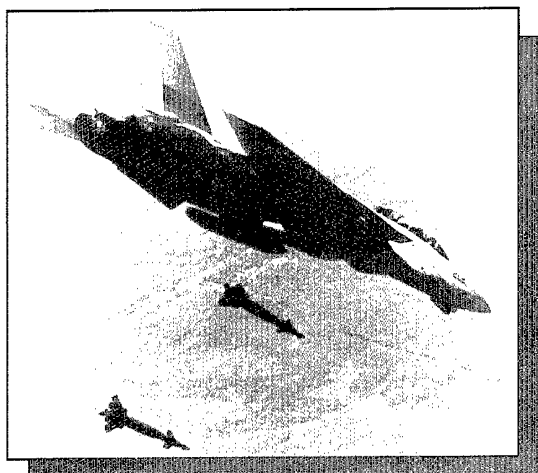
CROTALE NG (New Generation)

Iraq maintained a modern, well-equipped air force throughout the 1980s. New equipment, including the MIRAGE F-1 fighter-bomber, was purchased to replace Iran-Iraq war losses. Sophisticated French surface-to-air systems (CROTALE and ROLAND) were also acquired.

Although Iraq wishes to rebuild its air and air defense forces, stifling sanctions remain in place. If these sanctions are lifted, Iraq is likely to be an active marketplace for intense arms sales competition.

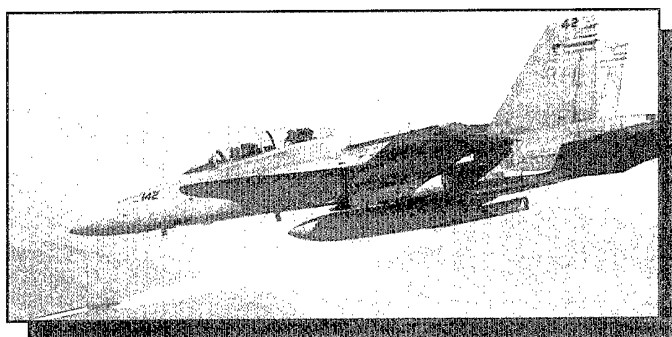


***H**OW STRIKE WARFARE COMPETES: SYNERGY*



F-14 TOMCAT drops laser guided bombs.

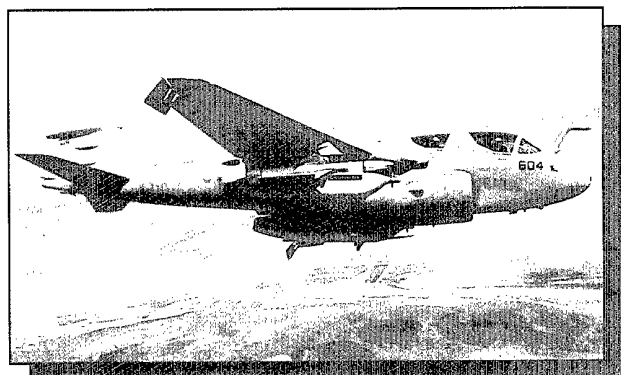
The United States and its allies have developed new concepts for conducting warfare. This change was made possible, in large part, through the refinement of smart weapons. The dramatic success of these weapons in recent actions has exposed potential weaknesses in military forces throughout the world. As has been addressed in this publication, counters to our current military technology are being considered around the globe. To retain the overwhelming advantages we enjoy today, the United States must remain engaged in the continuing research and development of promising new technologies and maintain its high levels of proficiency. This development cycle takes well over 10 years to complete, leading to the conclusion that we must already be considering technologies we wish to field in the 2015 timeframe. New versions of the F/A-18 and the



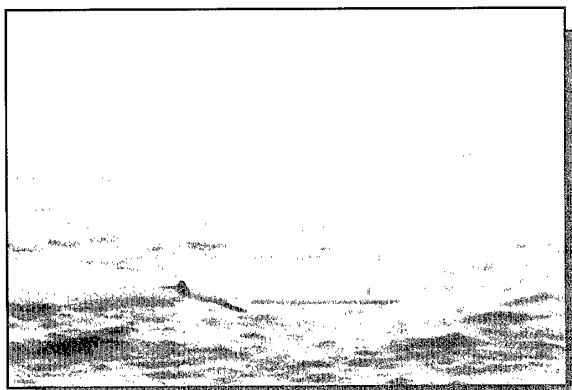
F/A-18D HORNET fires a rocket.

TOMAHAWK respond to the challenges anticipated in the near term, but research and development by those who will build the weapons of our adversaries has not stopped.

Synergy of technologies is the key to overall combat effectiveness of strike warfare forces. Studies have concluded that these forces will be suitable for future assigned missions, major campaigns, and contingency operations. Stand-off weapons, tactics, flight performance, signature reduction, electronic and information warfare systems have been blended to ensure the continued advantage of U.S. Naval strike warfare forces over potential opponents. As can be seen on the following pages, current and planned naval aircraft are well positioned to meet the future's challenge.



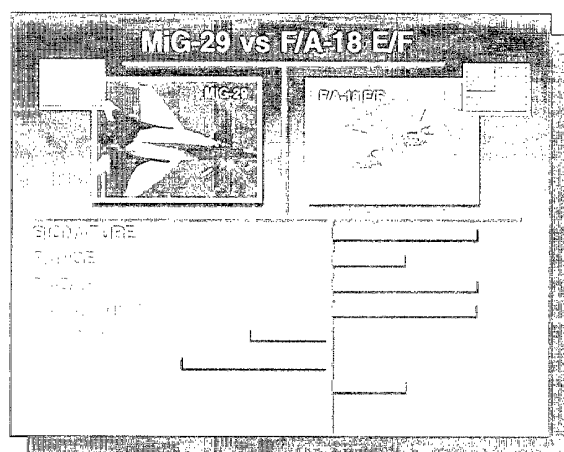
EA-6B PROWLER jamming aircraft with antiradar missiles.



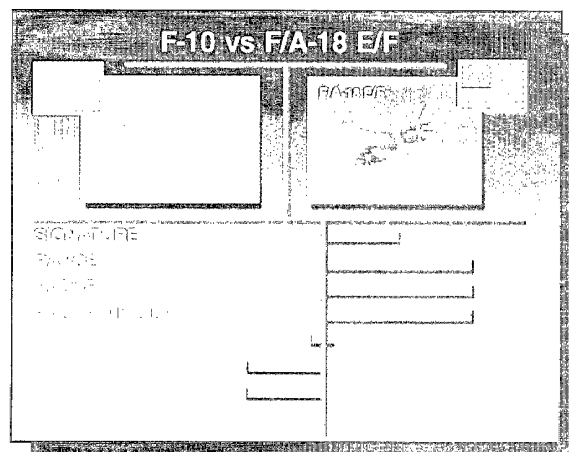
TOMAHAWK Cruise Missile

THE COMPETITION...

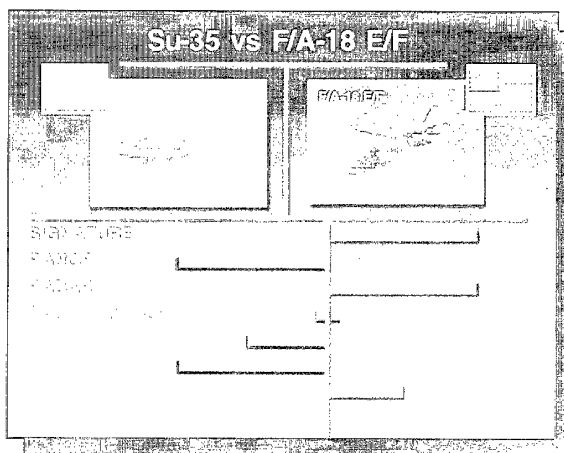
All aircraft are designed to optimize particular capabilities. The F/A-18 E/F provides an ideal blend of characteristics to achieve excellent overall performance. Particular strengths of the SUPER HORNET include the signature, radar, and radar missiles.



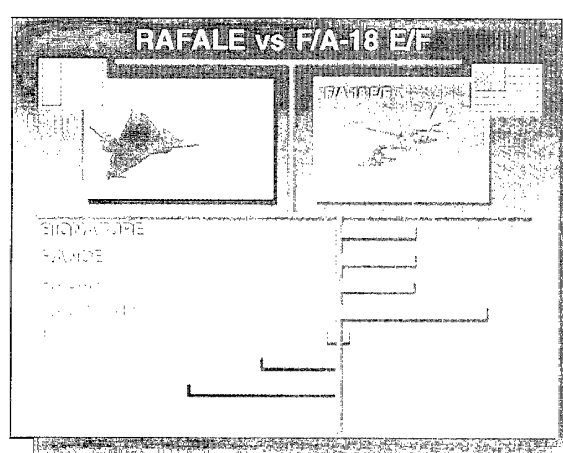
The MiG-29 has excellent dash speed, well over Mach 2.0. It also carries one of the best dogfight missiles in service today, the AA-11, and will likely carry its follow-on.



The F-10 represents a dramatic step forward for Chinese military aviation. The aircraft has particularly good agility.

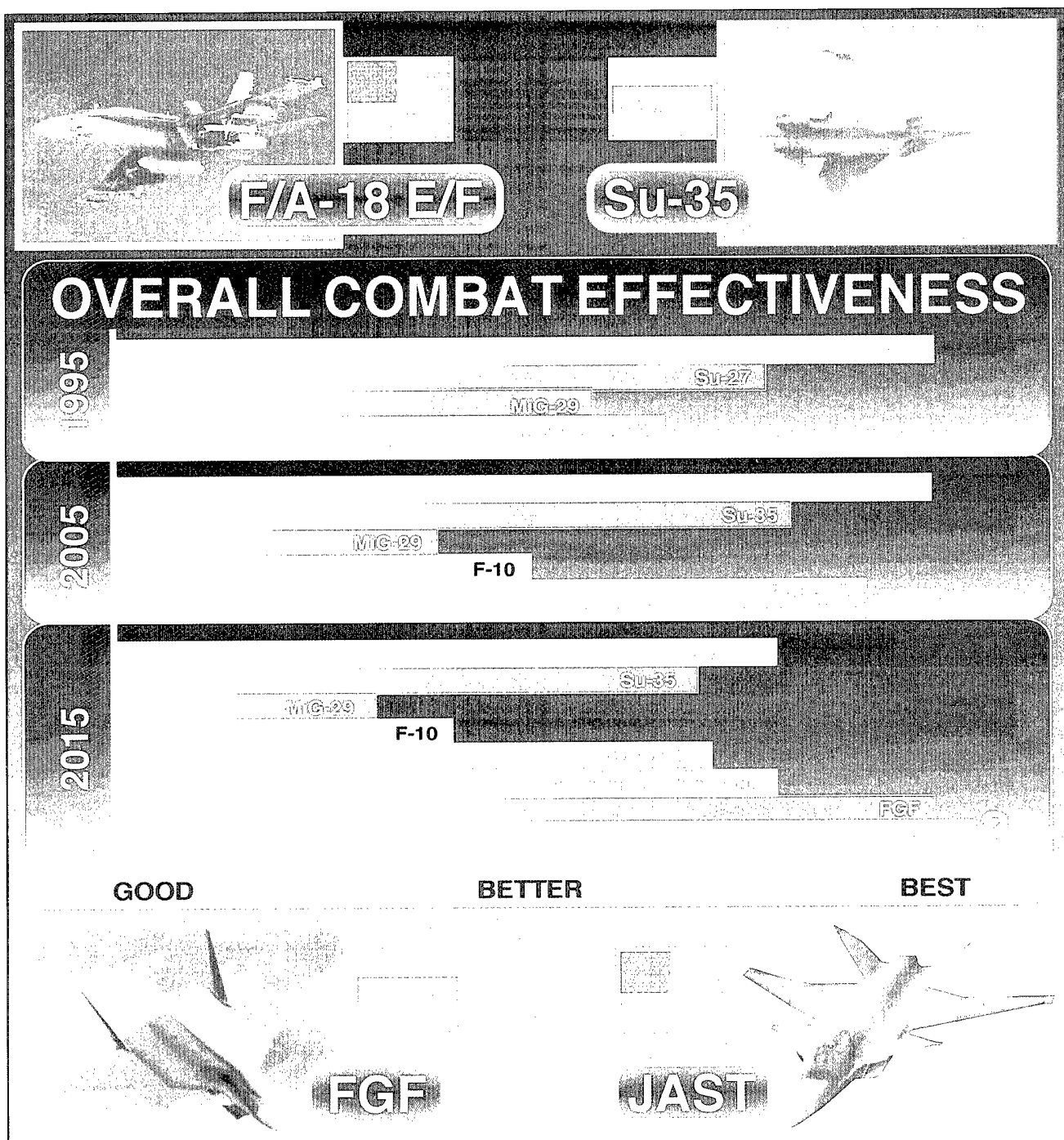


The Su-35 is a large aircraft with excellent range and speed. It carries advanced missiles, including the active radar AA-12 and the AA-11 dogfight weapon.



Like the F/A-18, the French RAFALE incorporates an excellent balance of characteristics. Its canard/delta wing configuration makes it extremely maneuverable.

FIGHTER AIR COMBAT COMPARISON



The F/A-18 E/F will enjoy a technological advantage over potential opponents until Russia's fifth generation fighter enters service around 2015.

..... THE OUTLOOK



Today, United States naval strike warfare units enjoy broad technological superiority over any potential opponent. This edge, however, will be eroded over time as proliferation is a fact of life in the modern world and cannot be prevented.

Advanced technologies that are likely to proliferate and are of the highest concern to U.S. Navy aircraft and cruise missile developers include the following:

Today, United States naval strike warfare units enjoy broad technological superiority over any potential opponent. This edge, however, will be eroded over time as proliferation is a fact of life in the modern world and cannot be prevented.

Advanced technologies that are likely to proliferate and are of the highest concern to U.S. Navy aircraft and cruise missile developers include the following:

- **Advanced radars:** Providing increased capability to detect low altitude and low signature targets and decreasing traditional warning clues.
- **Active radar seeker missiles:** Increasing lethality and multi-target capability for medium range air-to-air and surface-to-air systems.
- **Automated, integrated countermeasures suites:** Providing a bewildering array of deceptive and noise techniques to complicate all facets of an attack.
- **Helmet-mounted aiming systems with off-boresite missiles:** Providing first shot opportunities in the dogfight arena.
- **Reduced signatures:** Shortening reaction and warning times and complicating targeting.

Despite the proliferation of advanced conventional weapons systems, only if Russia returns to its previous military posture, or if China fully modernizes its forces, would the potential exist to deny U.S. naval strike forces completion of their goals. Foreign air and air defense forces are designed around the goal of defeating regional rivals rather than defeating the United States in an all-out military effort.

Emerging regional powers will continue to purchase advanced aircraft and surface-to-air missile systems with an eye toward achieving superiority over potentially hostile neighbors. If drawn into a regional conflict, U.S. naval forces could find themselves technologically challenged by selected foreign systems. Although these systems do not give a potential opponent the capability to defeat a U.S. led force, they could make the task more difficult and more costly.